

Taurus

Portable Seismograph

User Guide

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Taurus Portable Seismograph User Guide

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About This Document

Document Conventions

Essential and Supplementary Information

	Warning	Explains a risk of irreversible damage to data, software, or equipment and provides recommendations for preventive action.
	Caution	Explains a risk of damage to data, software, or equipment where recovery is likely to be troublesome and provides recommendations for preventive action.
	Note	Provides additional information related to the current text.
	Tip	Explains a best practice or provides helpful information related to the current text.
	Example	Provides an example related to the current text.

Text Conventions

bold text	Identifies referenced elements in the graphical user interface (GUI) (for example, "click Cancel to discard the changes").
<i>italic text</i>	Identifies variables such as parameter names and value placeholders (for example, "select Configuration > <i>Sensor Name</i> ").
<code>courier text</code>	Identifies commands that must be entered exactly as shown (for example, "type <code>mkdir \$APOLLO_LOCATION/config</code> ").

Changes Included in This Revision

Revision number 15148R7 includes the following changes:

- ◆ Extensive changes across the entire user guide to reflect the new functionality and features of Taurus version 3.x.

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Part 1

Getting Started

- ◆ [Quick Start Guide](#)
- ◆ [Operating a Taurus](#)
- ◆ [Monitoring and Maintaining a Taurus](#)

Chapter 1

Quick Start Guide

1.1 Introducing the Taurus Portable Seismograph

The Taurus Portable Seismograph is a compact, self-contained Digitizer and data logger that combines exceptional performance with versatility and low power consumption. The Taurus can be used either as a stand-alone time series data logger or as a component in a data acquisition network. The Taurus incorporates a three-channel 24-bit Digitizer, GPS receiver and system clock, removable data storage media, and remote communication options. The Taurus can be configured locally using the colour display screen and integrated browser and remotely using any Web browser over a TCP/IP connection.



We recommend that you use [Mozilla®Firefox®](#) as your Web browser.

The Taurus is equipped with three 24-bit data channels. Time series data is stored in Stein1 format. Data can be extracted to MiniSEED, MiniSEED Sorted, Seisan, SEG-Y, and ASCII formats. Data can also be streamed in NP and WIN formats. The Taurus supports 10/100Base-T Ethernet and serial interfaces. Communication protocols include UDP/IP, TCP/IP, SLIP, PPP, and HTTP.

As a portable unit, the Taurus can be deployed to record continuous data for extended periods of time. For example, when recording 3 channels at 100sps, up to 600 days of data can be recorded using a 40GB 1.8" hard disk drive. A CompactFlash (CF) card can also be used as an alternative to a hard drive to use, for example, at more extreme temperatures or altitudes or to realize optimal power consumption. The media is removable for easy data retrieval from the field. The extensive storage combined with low power consumption make the Taurus ideal for long-term unattended data acquisition.

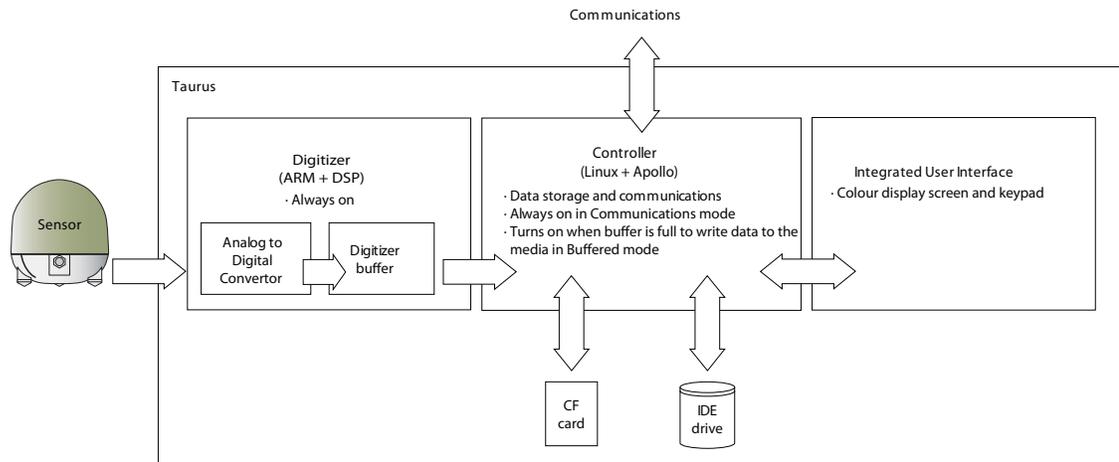
The software programmable front-end gain supports a wide range of sensor types, including many third party sensors. Nanometrics supplies cables of varying lengths for connecting the Taurus to sensors. For more information, see [Appendix C "Seismometer-Taurus Interconnection."](#)

1.1.1 Taurus Overview

Figure 1-1 shows the physical features of the Taurus and Figure 1-2 gives an overview of the Taurus subsystems.

Figure 1-1 Taurus overview



Figure 1-2 Taurus subsystems

1.1.2 Channel Expansion through Trident 305 Integration

You can connect up to two Trident 305 Digitizers to a Taurus using a simple, twisted pair NMXbus cable, which can be extended up to hundreds of meters in length, and expand the total number of channels supported by a single Taurus from three to six or nine channels.

You can view and configure Trident 305 settings on the Configuration pages and you can view the following information for each Trident 305 connected to the Taurus:

- Waveform
- SOH
- Data availability
- Sensor
- System Information

1.1.3 Downloading Data using Apollo Project

Apollo Project is a server-based software program for managing the download of large data sets from multiple Taurus seismometers. You create and configure projects using a Web browser and Apollo Project locates the data, downloads the requested time series, combines the data into network files, and outputs the data in the format of choice.

For more information on how to do this, see the Apollo Project User Guide.

1.1.4 Taurus Cables

You can purchase the following cables from Nanometrics for use with your Taurus Portable Seismograph:

Table 1-1 Taurus cables

Name	Part Number	Description
Cable – Taurus to Trillium seismometer	16169-3M 16169-5M 16169-10M 16169-15M 16169-25M	A double-shielded, ultra-flexible cable with a Taurus right-angled connector on one end and a Trillium seismometer connector on the other end for connecting a Taurus to a Trillium seismometer Available in lengths of 3 m, 5 m, 15 m, and 25 m Custom cable lengths are available upon request.
Cable – Taurus to Trillium seismometer, regulating	16163-3M 16163-5M 16163-10M 16163-15M 16163-25M	A double-shielded, ultra-flexible cable with a Taurus right-angled connector on one end and a Trillium seismometer connector on the other end for connecting a Taurus to a Trillium seismometer The Taurus connector contains a power supply that filters out power-induced noise. Available in lengths of 3 m, 5 m, 15 m, and 25 m Custom cable lengths are available upon request.
Cable – Taurus to open end	16171-3M 16171-5M 16171-15M 16171-25M	An ultra-flexible cable with a Taurus connector on one end and open ended at the other end for attaching the connector of a third-party seismometer Available in lengths of 3 m, 5 m, 15 m, and 25 m Custom cable lengths are available upon request.
Power cable	14983-3M 14983-5M 14983-6M 14983-8M 14983-10M	An unshielded 22 AWG power cable Available in lengths of 3 m, 5 m, 6 m, 8 m, and 10 m
Power cable	14268-3M 14268-5M 14268-10M 14268-15M	A shielded 18 AWG power cable Available in lengths of 3 m, 5 m, 10 m, and 15 m
Ethernet cable	15228-10M	A 10 m Ethernet cable



You can also build your own seismometer cables. For more information, see [Appendix B “Connector Pinouts”](#) and [Appendix C “Seismometer-Taurus Interconnection.”](#)

1.2 Installing a Taurus

A Taurus can be installed as a stand-alone unit to record continuous data on removable media for extended periods of time or as a network component that allows data downloads, data streaming, and remote configuration changes while also recording data to the storage medium.

The shipping box and packing foam for the Taurus have been designed and tested to protect the Taurus against accidental drops during hand-carrying and vibration and shock during shipping. To maintain warranty protection, the Taurus must always be transported in packaging approved by Nanometrics. Save the original packaging and reuse it any time you are transporting a Taurus. If custom packaging is required for a particular application, please contact Nanometrics (see [Contacting Technical Support](#) on page 175).

After transporting a Taurus to its installation site, you can safely remove it from the packaging and handle it with no special precautions but do not drop it or bang it against hard surfaces. When you unpack the Taurus, make sure that the following items are included with the shipment:

- Ethernet cable (1 m)
- GPS patch antenna with cable (5 m)
- Software CD

1.2.1 Tools and Materials Needed to Install a Taurus

To install a Taurus, you should have the following tools and materials available:

Table 1-2 Installation tools and materials

Name	Description
Grounding wire	To connect the Taurus to the site ground. Note: 10 AWG is recommended. Cut the cable to length to remove excess and minimize voltage drop.
1 grounding lug, M4	To ground the Taurus Note: The grounding lug must accommodate the gauge of the grounding wire used.

1.2.2 Installing and Deploying a Taurus

To install and deploy a Taurus

1. Plan the physical installation (for example the power system, proper equipment grounding, and location of the GPS antenna).
2. Choose a deployment option appropriate for your project:
 - ▶ Install the Taurus as a stand-alone data recorder.

For stand-alone recording where network access is not required, you should configure the Taurus to run in Buffered mode. It consumes less power in this mode as the Controller only runs when the Taurus is recording buffered data to the Store. In Buffered mode, the Taurus only records data to the Store when the buffer is full or when you press the centre key on the display screen.
 - ▶ Install the Taurus in a network.

For networked operation, you must configure the Taurus to run in Communications mode and configure the appropriate network options. In this mode, the Controller is running continuously. It consumes more power than Buffered mode but allows continuous access via an IP connection and data streaming.
3. In the lab, configure the Taurus as required (see [Section 1.3 "Viewing or Changing Configuration Settings"](#) on page 12).

The as-shipped configuration of a Taurus includes various default settings, but the set up of the Taurus will include changing some of these settings as appropriate (see [Section 1.3 "Viewing or Changing Configuration Settings"](#) on page 12 for an overview and relevant chapters in [Part 2](#) for detailed information).



It is recommended that you do most of the configuration before field deployment using a Web browser over a network connection. You can also use the Taurus display screen and keypad to change the configuration in the field.

4. Install and level the seismometer.

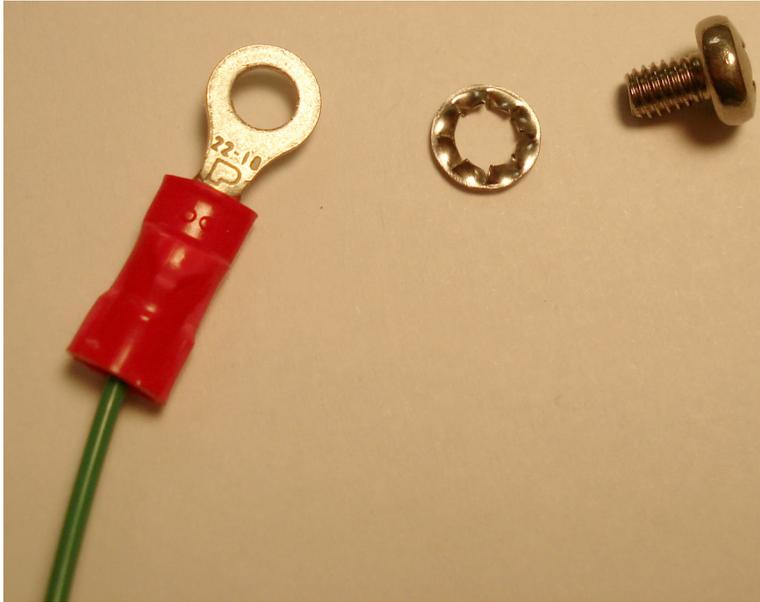
For more information, refer to the seismometer documentation.
5. Mount the GPS antenna with a good view of the sky and ensure that the antenna cable is installed with sufficient strain relief.

Figure 1-3 Mount the GPS antenna (optional bullet antenna shown)



6. Strip one end of the grounding wire and crimp the grounding lug around the grounding wire.

7. Attach the grounding lug to the grounding hole (see [Figure 4-2 on page 43](#)) using the M4x5 screw and the M4 lock washer.



8. Connect the other end of the grounding wire to a grounding point at the site.
For more information, see [Section 4.2 "Grounding a Taurus Installation"](#) on page 42.
9. Ensure that a supported recording medium is installed in the Taurus media slot.
For more information, see [Section 1.4 "Installing Recording Media"](#) on page 14.
10. Connect the seismometer to the Taurus.
11. If you will be accessing the Taurus over a network, connect the Taurus Ethernet cable or a serial cable (see [Chapter 6 "Configuring Taurus Communications"](#)).
12. Power up the Taurus and start the display screen.
Connect the power cable to start the Taurus up in the mode it was in before the last shut down. It will take the Taurus a minute or two to boot. While the unit is booting, the display screen will be off and the SuperLED will indicate the status (see [Section 3.2 "Status LEDs"](#) on page 32).
Wait 2 minutes after connecting power and then start the display screen by pressing and holding the centre key for about 1 second. It might take a minute for the display to start up.
For more information, see [Chapter 4 "Powering a Taurus."](#)
13. If the Taurus is going to operate in Buffered mode, select **Configuration > General** and set the Taurus Running Mode to Buffered before you leave the Taurus.
14. Ensure that the Taurus is sealed environmentally (see [Section 1.2.5 "Environmental Seals"](#) on page 11).
15. Ensure that the SuperLED is blinking green before you leave the Taurus.
When the SuperLED blinks green, this indicates that all systems are operating as configured and no problems are detected. If the SuperLED is blinking yellow or red, use the Status page indicators to help you find the problem (see [Section G.1.1 "Status](#)

[Details Page](#)" on page 139 for more detailed information on interpreting the status bar colours).

If the display screen is off, press the centre key for about 1 second and wait for the display to start up. It will open to the Status page.

16. View the information on the Status page to check the operational status of the Taurus.
 - a) Verify that the status bar is green.

A green status bar indicates that the Taurus is ready to capture data. A yellow status bar indicates that the Taurus is acquiring and calculating status information. A red status bar indicates an error condition. The colour of the status bar matches the colour of the SuperLED.



See [Section G.1.1 "Status Details Page"](#) on page 139 for more detailed information on interpreting the status bar colours.

- b) Verify that waveform images are displayed and that the number of packets is increasing.



You should make a note of the IP address listed on the Status page. This is the address you will use to connect to the Taurus via a Web browser. If you cannot view the IP address on the Status page of the Taurus display screen, see [Section 2.1.2.1 "Troubleshooting: Viewing the IP Address"](#) on page 19.

1.2.3 Powering and Grounding Considerations

- ▶ See [Section A.13 "Power"](#) on page 113 for power specifications and [Chapter 4 "Powering a Taurus"](#) for information on powering the Taurus.
- ▶ See [Section 4.2 "Grounding a Taurus Installation"](#) on page 42 and [Appendix C "Seismometer-Taurus Interconnection"](#) for guidelines on equipment and signal grounding.
- ▶ It is recommended that you use the Shutdown option to power down the Controller before disconnecting the power from the Taurus. For more information, see [Section 2.2.2 "Shutting Down the Controller"](#) on page 22.



If you disconnect the power while the Controller is running, you might lose data presently cached in the buffer. This can be about 15 seconds of data if the Taurus is running in Communications mode and up to several hours of data if the Taurus is running in Buffered mode, depending on the sample rate, seismic signal and noise, and number of channels configured (for example, typically about 30 minutes of data for 3 channels at 100sps). Also, if the Store is not closed down properly, it might need to perform a lengthy reindexing on the next start-up (see [Section 9.1.3 "Reindexing Stores"](#) on page 83).

Do not press and hold the centre key on the display screen for more than 4 seconds as this will cause a hard shut down of the Taurus Controller. A hard shut down immediately terminates various processes and might cause detrimental effects.

1.2.4 Sensor Configuration Considerations

Before a sensor can be calibrated, the Taurus must be properly configured for the installed sensor. For descriptions of the sensor configuration settings, see [Section H.10 “Sensor Library”](#) on page 166.

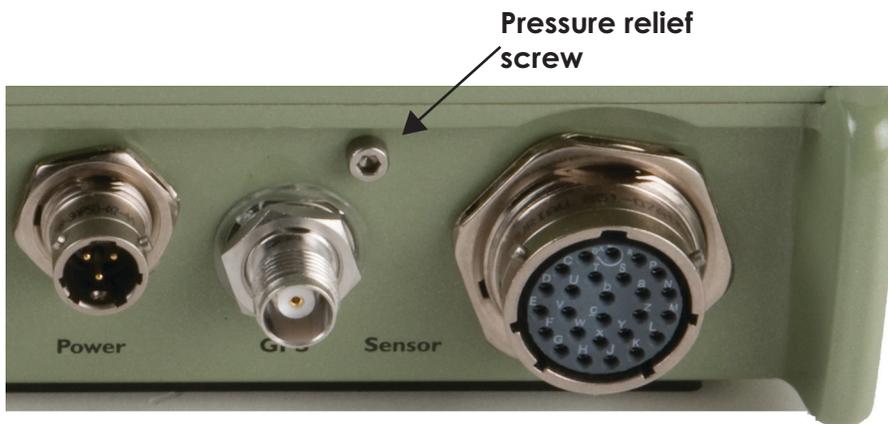
1. Configure the Taurus for the installed sensor either by selecting a default sensor configuration or by creating a new one.
2. Go to the Configuration > Calibration page and configure the
 - Type of calibration
 - Waveform parameters
 - Channels to be calibrated
3. Go to the Sensor page and select the Start Calibration button .

1.2.5 Environmental Seals

The Taurus can be sealed against dust and moisture. You should confirm the following before you leave a Taurus installation:

- ♦ The media door is closed with the doorknob locked and the black plastic lever in the down position.
- ♦ All Taurus connectors are either occupied by the appropriate cable connector or are sealed with the optional factory-installed dust caps or equivalent.
- ♦ The self-sealing pressure relief screw is torqued to hand tight ([Figure 1-4](#)). This screw is a slot head on older models and is a 2.5mm hex Allen key on newer models.

Figure 1-4 Pressure relief screw



1.2.6 Recording Your Serial Number

The serial number is located on the back of the Taurus. Record the serial number and keep it accessible. You will need to reference this number if you need to contact Nanometrics Technical Support.

1.2.7 Technical Support and Maintenance

If you need technical support, please submit your request by email. Include a full explanation of the problem and supporting data, to help us direct your request to the most knowledgeable person for reply. Before returning a unit for repair, contact Nanometrics Technical Support to obtain an RMA number.

The Taurus Portable Seismograph mechanical and electronic elements have been designed to be robust and reliable, to ensure there is no need to open units for on-site maintenance.

1.3 Viewing or Changing Configuration Settings

You can view and change configuration settings using the Taurus display screen and keypad or by using a Web browser via an IP connection.

1.3.1 Making Configuration Changes

To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: tech or central.



Always select the **Previous** button to navigate back through configuration pages to preserve unapplied changes. If you use the Web browser's Back button, unapplied configuration changes are discarded.

To change the configuration of a Taurus

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)

2. If required, enter a user name and password.

For more information, see [Section 2.3.1 "Logging In"](#) on page 24.

3. If you do not have any Trident 305 Digitizers connected to the Taurus, go to [step 4](#).

-OR-

Select the Taurus or Trident 305 you want to configure.

4. Select the configuration category that contains the settings you want to change.

Category	For an overview of the settings, see
General	Section H.2 "General" on page 149
Data Streaming	Section H.4 "Data Streaming" on page 152
Data Retrieval	Section H.6 "Data Retrieval" on page 156
Digitizer	Section H.8 "Digitizer" on page 158
Sensor Library	Section H.10 "Sensor Library" on page 166
Communications	Section H.3 "Communications" on page 150
Security	Section H.5 "Security" on page 156
Calibration	Section H.7 "Calibration" on page 157
Power Manager	Section H.9 "Power Manager" on page 164

5. Change the value of one or more of the settings as required.
 - ▶ You can select **Reset** to undo any changes that have not been applied.
6. Select **Apply** to view the results of your changes.
 - ▶ If necessary, you can undo the changes you applied. For information on how to do this, see [Section 5.1.2 "Undoing Applied Changes"](#) on page 50.
7. Select **Commit** to permanently save the changes you made.

1.3.2 Checking Basic Configuration Settings

There are some basic settings you might want to check before making other configuration changes:

- ▶ Running mode

There are two basic running modes: Buffered and Communication. Once the display screen shuts down, the Taurus operates in the configured running mode. Buffered mode is the most power efficient, whereas Communications mode allows continuous access via an IP connection. For more information, see [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27.

- ▶ Number of channels
- ▶ Digitizer sample rate
- ▶ Data retrieval settings

Downloaded data files will use the network and station definitions as entered on the Data Retrieval page.



You can make all of the configuration changes at the same time and then select **Apply** and **Commit** once to apply and save them all at once.

1.4 Installing Recording Media

The Taurus can record data on a CompactFlash card (CF) or a 1.8" ATA hard drive (IDE hard drive) formatted as a Linux ext3 file system. For recording media specifications, see [Section A.6 "Internal Data Storage"](#) on page 111.



You can damage the Store or the recording media if you insert or remove the media while the Controller is running. Do not remove or insert media if the Media Status LED is red or yellow (solid or blinking). Wait until the Controller has shut down and the Media Status LED is green. For more information, see [Section 3.2 "Status LEDs"](#) on page 32.

To install recording media

1. Click  and select **Shutdown** from the main menu. (Web browser)

-OR-

Press the top key to open the main menu, press the bottom key to select **Shutdown**, and press the centre key. (display screen)

2. Select **Shutdown**.
3. Open the media door ([Figure 9-1](#) on page 85).
4. Remove or insert recording media as required.

For more information, see [Section 9.2.1 "Replacing Recording Media"](#) on page 84.

5. Close the media door.

Closing the media door will start the Controller. If you want to start the display screen, press the centre key for about 1 second. The display will start up once the Controller has finished booting.

6. If the media you inserted was not formatted, you can format it on the Store Tools page.

For information on how to do this, see [Section 9.2.2 "Formatting Recording Media"](#) on page 86.

-OR-

If you inserted formatted media, the Taurus will

- Create a new Store using the last configured Store size setting, if the medium does not contain a Store
- OR-
- Automatically start adding data to the existing Store (see [Section 9.1.1.1 "About Appended Stores"](#) on page 82)



If you do not want to have the new data appended to an existing Store (for example, if it was created on a different Taurus), you can either reformat the medium or delete and recreate the existing Store.

1.5 Formatting Recording Media

You can use the Taurus to format recording media to the Linux ext3 file system. For a description of formatting options and procedures, see [Section 9.2.2 "Formatting Recording Media"](#) on page 86.

1.6 Retrieving Data From a Taurus

Time series data, state of health (SOH) data, logs, and system configuration information are recorded in the Nanometrics Store. There are various methods for accessing this data:

- ▶ Retrieve data from the Store to files on your network using options in an external Web browser over an IP connection.
 - Time series data can be extracted in the following formats: MiniSEED, MiniSEED Sorted, ASCII, SEG-Y, or Seisan ([Section 10.3 "Retrieving Time Series Data"](#) on page 90).
 - Other information, such as SOH data, logs, and configuration information can be downloaded as described in [Section 10.2 "Retrieving and Accessing Data"](#) on page 89.
- ▶ Access data on removed recording media ([Section 10.9 "Accessing Store Files on the Recording Media"](#) on page 100).
- ▶ Stream time series data from a Taurus to a Nanometrics acquisition system (for example, an Apollo Server) over an IP connection ([Section 11.1 "Streaming Data in NP Format"](#) on page 101 or [Section 11.2 "Streaming Seismic Data in WIN Format"](#) on page 104).

Chapter 2

Operating a Taurus

2.1 Using the Taurus User Interface

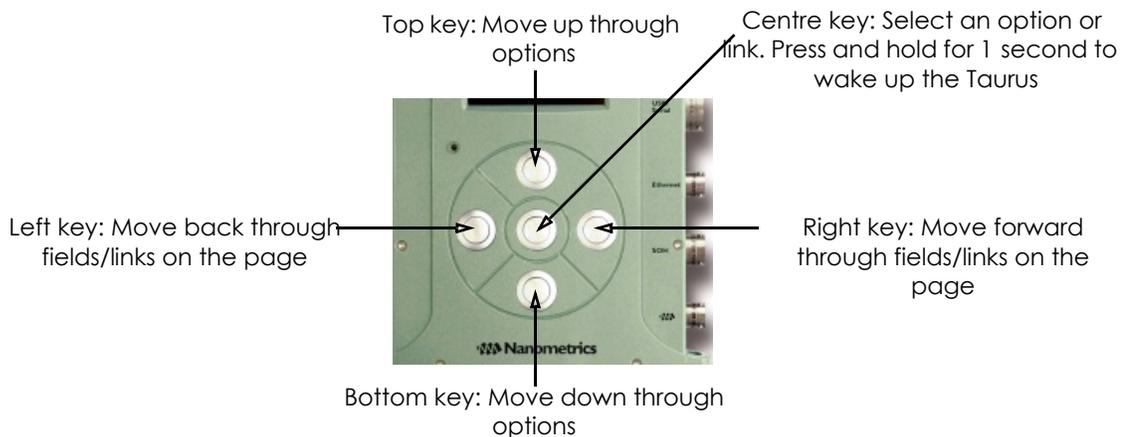
You can access the Taurus user interface pages using a Taurus display screen or using a Web browser over an IP connection.

For more information, see [Section 2.1.1 "Using the Taurus Display Screen"](#) on page 17 or [Section 2.1.2 "Using a Web Browser"](#) on page 18.

2.1.1 Using the Taurus Display Screen

The Taurus has a 5-key keypad ([Figure 2-1 "Taurus keypad functions"](#) on page 17) for starting the Taurus and for selecting options on the display screen.

Figure 2-1 Taurus keypad functions



2.1.1.1 Using the Virtual Keyboard

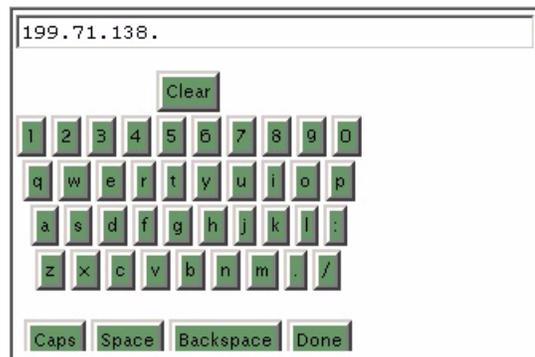
The Taurus provides you with a virtual keyboard that you can use to enter text on the display screen using the Taurus keypad ([Figure 2-2](#)).

1. Select the **Keys** link beside the box where you want to enter a value.
2. Use the Taurus keypad to select numbers and letters.

Alphanumeric selections will be entered in the field at the top of the screen.

3. Once you have finished entering the value, select the **Done** button to exit the keys page.

Figure 2-2 Virtual keyboard for text field entries on the display



2.1.1.2 Turning Off the Display Screen

1. Press the keys on the Taurus display screen to open the main menu and select the **Shutdown** page.
2. Select **Turn Off Display**.

2.1.2 Using a Web Browser

You can access the Taurus user interface using a Web browser over an IP connection. The Taurus must be in either Communications mode or Interactive mode and the network cable must be connected before the Taurus is started. For more information, see [Chapter 6 “Configuring Taurus Communications.”](#)



You must have cookies enabled in your Web browser to access the Taurus user interface.

1. Connect to the Taurus using any of these methods:
 - ▶ Use the Ethernet cable (15228) to connect the Taurus to your LAN or to connect your computer directly to the Taurus.
 - ▶ Connect to the Taurus using a serial (or PPP) connection.

2. Start the Taurus.

For information on how to do this, see [Section 2.2 “Starting Up and Shutting Down”](#) on page 21.

3. Type the IP address of the Taurus into the Address bar of your browser.

If you do not know the IP address of the Taurus, you can start the display screen. The IP address is shown on the Status page. If you cannot view the IP address on the Status page of the Taurus display screen, see [Section 2.1.2.1 “Troubleshooting: Viewing the IP Address”](#) on page 19.



If you use the Back and Forward buttons of your Web browser to navigate through the Taurus user interface pages, any changes you make will be lost.

2.1.2.1 Troubleshooting: Viewing the IP Address

If you cannot view the IP address on the Status page of the Taurus display screen, you can access the Taurus by performing the following steps on a laptop running Windows:

1. Ensure that the Internet Protocol (TCP/IP) properties are set to obtain an IP address automatically.
2. Disconnect the laptop from the Local Area Network by unplugging the network cable.
3. Restart the laptop.
4. Connect the Taurus to the laptop using the Ethernet cable.
5. Type the following IP address into the Address bar of your browser: 169.254.2.2
6. Make a note of the IP address that is displayed on the Status page and type that IP address into the Address bar of your browser to access the Taurus.

If the IP address of the Taurus is not displayed on the Status page, perform the following steps:

- a) Telnet to 169.254.2.2.
- b) Log in and type `ifconfig eth0`.

The IP address is displayed on the second line (after `inet addr`).

Example:

```
taurus_0116$ ifconfig eth0
eth0   Link encap:Ethernet  HWaddr 00:11:40:02:00:30
        inet addr:10.11.2.51  Bcast:10.255.255.255  Mask:255.255.0.0
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:361076  errors:6  dropped:0  overruns:0  frame:6
        TX packets:306781  errors:0  dropped:0  overruns:0  carrier:0
        collisions:0  txqueuelen:1000
        RX bytes:43537585 (41.5 MiB)  TX bytes:213367176 (203.4 MiB)
        Base address:0xe00
```

2.1.3 Navigating the Taurus UI pages

The Taurus UI Web pages show real-time status information and provide configuration, data download, and firmware upgrade options. You can access the UI pages using the Taurus display screen and using any Web browser with IP access to the Taurus. (See [Appendix G “UI Pages”](#) for a summary of the UI pages and options.)



The Taurus Web interface normally refreshes every 5 seconds. The Taurus will detect if a communications link is slow and will reduce the interface refresh rate to attempt to compensate for the link speed.



You can click the Pause automatic refresh button  at the top of the Status, Waveform, SOH, Timing, and Sensor pages to stop the page from refreshing automatically.

The page will also stop refreshing automatically if you are inactive for more than 30 minutes.

You can click the Start automatic refresh button  to start automatic refreshing again.

2.1.3.1 Selecting Pages and Links

The Taurus user interface is comprised of one main menu containing several pages. You can open the main menu (see [Figure 2-3 “Main menu in the Taurus user interface”](#) on page 20) by selecting the arrow  in a Web browser or by pressing the centre key on the Taurus keypad.

Figure 2-3 Main menu in the Taurus user interface



You can scroll through the list of pages and select a page:

- Use the mouse wheel button to scroll through the list and left-click a page to view it.
- OR-
- Use the top and bottom keys on the Taurus keypad to scroll through the list and press the centre key to select a page.

Several pages have hyperlinked subpages. You can view these pages by

- Left-clicking the blue hyperlink.
- OR-
- Using the Taurus keypad keys to highlight the hyperlink you want to select and pressing the centre button to view the page.



The default home page is the Status page. You can use the Home button  to return to the Status page.



If you use the Back and Forward buttons of your Web browser to navigate through the Taurus user interface pages, any changes you make will be lost.

2.2 Starting Up and Shutting Down

The Taurus Digitizer, Controller, and timing are started up as soon as you connect power to the Taurus. Typically it takes about 3 minutes for these Taurus systems to finish booting when power is first connected.

About 2 minutes after connecting power to the Taurus, you can start the Taurus display screen:

- ▶ Press and hold the centre key for 1 second.

The display screen will start in about 50 to 90 seconds.



If the supply voltage exceeds either of the configured voltage disconnect settings (that is, it is either lower than the Battery Low value or higher than the Battery High level), the Taurus will not power up. See [Section 4.3.2.1 "Bypassing the Power Supply Threshold Settings on Start-Up"](#) on page 46.

2.2.1 Starting the Controller

The Taurus Controller manages operations such as communications and networking, the Taurus display screen and user interface, and the recording media. The Taurus Digitizer operates continuously whether or not the Controller is running. The options on the Shutdown page (such as Restart) and a hard shut down with the centre key apply only to the Controller, they do not affect the Digitizer.



It is possible to do a hard shut down of the Controller by pressing the centre key for about 5 seconds but this is not recommended. A hard shut down will interrupt various processes and might cause detrimental effects, such as causing the Store to require reindexing.

While the Controller is running you have access to the Taurus over an IP connection and applied configuration changes are held in volatile memory (memory that requires power to maintain the stored information). Once the Controller shuts down, you no longer have IP access to the Taurus and any uncommitted changes in the volatile memory for Controller-based functions will be lost.

The Controller will start up when

- ♦ You connect power to the Taurus
- ♦ You press the centre key for 1 second
- ♦ The buffer fills up in Buffered mode or when the buffer fills up after a shut down in Communications mode (if the configured media type is installed).

2.2.2 Shutting Down the Controller

The Shutdown option shuts down the Controller gracefully. This does not turn off the Digitizer, which continues to collect and buffer data.



Always ensure the Controller is shut down before removing or inserting recording media. For more information, see [Section 9.2.1 "Replacing Recording Media"](#) on page 84.

The time elapsed before the buffer fills depends on factors such as the number of active channels, sample rate, seismic signal and noise, and buffer size.



It is recommended that you use Shutdown to shut down the Controller before disconnecting the power. If you disconnect the power while the Controller is running, you might lose data presently cached in the buffer. This can be about 15 seconds of data if the Taurus is running in Communications mode and up to several hours of data if the Taurus is running in Buffered mode depending on factors such as the sample rate and number of channels configured. Also, if the Store is not closed down properly, it might need to perform a lengthy reindexing on the next start-up (see [Section 9.1.3 "Reindexing Stores"](#) on page 83).

To shut down the Controller

1. Click  and select **Shutdown** from the main menu. (Web browser)

-OR-

Press the top key to open the main menu, press the bottom key to select **Shutdown**, and press the centre key. (display screen)

2. Select **Shutdown**.

The status LEDs indicate when shut down has completed:

- The SuperLED has switched to a slow blinking pattern.
- The Media Status LED is green.
- The Ethernet Status LED is off.



If the Taurus is in Buffered mode, the Controller will normally be shut down already. If the Controller is running, it is writing buffered data to the medium and will shut down automatically when it has finished writing the data. For more information, see [Section 2.4.1 "Communications Mode Versus Buffered Mode"](#) on page 27.

To use Shutdown in Buffered mode, wake the display first (press the centre key for 1 second and wait for the display screen to start) so that you can access the Shutdown option. You might want to do this to ensure any remaining buffered data is written to the recording medium before you remove media or power down the Taurus.



It is possible to do a hard shut down of the Controller by pressing the centre key for about 5 seconds but this is not recommended. A hard shut down will interrupt various processes and might cause detrimental effects, such as causing the Store to require reindexing.

2.2.3 Restarting the Controller

You can use the Restart option to reboot the Taurus. The Taurus continues to buffer data during a restart.

To restart the Controller

1. Click  and select **Shutdown** from the main menu. (Web browser)

-OR-

Press the top key to open the main menu, press the bottom key to select **Shutdown**, and press the centre key. (display screen)

2. Select **Restart**.

2.3 Logging In and Off

As a user, you have two ways to access a Taurus (Web browser or Taurus display screen) and you have four options for operating a Taurus:

- Logging in using the *central* user account
- Logging in using the *tech* user account
- Logging in using the *user* user account
- Not logging in

[Table 2-1](#) shows the permissions and roles for each of the different options.

Table 2-1 User roles and permissions

User account name	Default password	Role	Permissions to
central	central	securityAdmin	<ul style="list-style-type: none"> ♦ Configure security ♦ Configure system ♦ Manage data Store and recording media ♦ Command sensor ♦ Download all data types ♦ Restart ♦ Shut down ♦ Upgrade
tech	tech	maintenance	<ul style="list-style-type: none"> ♦ Configure system ♦ Manage data Store and recording media ♦ Command sensor ♦ Download all data types ♦ Restart ♦ Shut down

Table 2-1 User roles and permissions

User account name	Default password	Role	Permissions to
user	user	operator	<ul style="list-style-type: none"> ♦ Manage data Store and recording media ♦ Command sensor ♦ Download all data types ♦ Restart ♦ Shut down
Not logged in		not defined	<ul style="list-style-type: none"> ♦ Format active medium (if unformatted)/switch media on start-up ♦ Command sensor ♦ Download all data types ♦ Restart ♦ Shut down

2.3.1 Logging In

You can log in using a Web browser or the Taurus display screen. If you use the display screen, you have the additional option of performing a Quick Login (see [Section 2.3.1.2 "Quick Log In Using the Display Screen"](#) on page 25.)

2.3.1.1 Standard Log In

1. Click  and select **Log In** from the main menu. (Web browser)
-OR-
Press the top key to open the main menu, press the bottom key to select **Log In**, and press the centre key. (display screen)
2. Type a user name in the User ID box and the corresponding password in the Password box and click **Log In**. (Web browser)
-OR-
 1. Select a User ID from the list. (display screen)
 2. Select **Keys** and press the centre key.
 3. Press the keys to type the corresponding password and select **Done**.
 4. Select **Log In**.



If you did not log in successfully, you can go back to the Log In page and try again. There is no limit on the number of login attempts.

All passwords are case-sensitive.

2.3.1.2 Quick Log In Using the Display Screen

There are two ways to log in using the display screen: Standard and Quick Login.

You can configure Taurus to use Quick Login for local authentication. It allows you to log in without having to enter the password for the user account. Quick Login is only available on the display screen.

Once Quick Login is configured as the Local Authentication type, the Log In page on the Taurus display screen will give you the option to **Log In as <user>**. For example, if you configured the Quick Login to use the `central` account, the name of the button is **Log In as central**.

To configure Quick Login

1. Log in using the `central` user account and open the Configuration > Security page.
2. Select **Quick Login** from the Local Authentication list and then select the appropriate account from the Quick Login User ID list.
3. Select **Apply**.
4. Select **Commit**.



To disable the Quick Login option on the Taurus display screen, repeat steps 1 to 4 and select **Standard** from the Local Authentication list.

2.3.2 Logging Off

We recommend that you log off of the Taurus before you close your Web browser window or when you have finished using the Taurus display screen.



You are automatically logged off if you close your Web browser window or if you are inactive for more than 30 minutes. The Taurus display screen will also turn off automatically.

To log off of the Taurus

1. Click  and select **Log Off** from the main menu. (Web browser)

-OR-

Press the top key to open the main menu, press the bottom key to select **Log Off**, and press the centre key. (display screen)

2. Select **Log Off** to confirm that you want to log off.

To exit this page without logging off, select **Cancel**.

2.3.3 Changing Passwords

You can change the default passwords of the three user accounts: central, tech, and user. All passwords are case-sensitive.

To change a password

1. Log off if you are currently logged in.
2. Open the **Log In** page and select the **Change Password** link.
3. Type the current user ID in the User ID box.
4. Type the current password in the Current password box.
5. Type the new password in the New password box.

The new password must be at least 4 alphanumeric characters long. All passwords are case-sensitive.

6. Type the new password in the Verify new password box.
7. Select **Save**.

You will be logged in to that account automatically.

2.3.3.1 Resetting to Default Passwords

If required, you can revert to the default set of passwords listed in [Table 2-1 "User roles and permissions"](#) on page 23.

To reset all passwords to the default settings

1. Access the Taurus via telnet or SSH.
For information on how to do this, see [Section 2.6 "Accessing the Taurus File System via FTP, Telnet, and SSH"](#) on page 30.
2. Delete the file `/home/apollo/users.txt`.
3. Click  in the Web browser user interface and select **Shutdown** from the main menu.
4. Click **Restart**.

2.4 Selecting the Taurus Running Mode

The Taurus has two running modes: Communications or Buffered.

2.4.1 Communications Mode Versus Buffered Mode

When the Taurus is running in Communications mode, data is written continuously to the data Store and it can also be downloaded or streamed to another device. The Communications mode consumes more power than Buffered mode because the Controller is always on (writing data to the Store), but you can communicate with the Taurus continuously via an IP connection because the Web server is always on.

When the Taurus is running in Buffered mode, the Taurus buffers the data and wakes the Controller only to write data to the Store when the buffer is full. Buffered mode consumes the least power of the 2 running modes. You cannot always access the Taurus via an IP connection when it is in Buffered mode because the Web server is only on at the beginning of the Buffered mode or if you force it to turn on using the `curl` command line tool. For information on how to do this, see [Section 2.5.1 "Forcing the Web Server to Turn On \(Buffered Mode\)"](#) on page 29.



The time it takes for the buffer to fill ranges from a few minutes to several hours, depending on the number of active channels, input signal activity, the sample rate, and the size of the buffer (2MB on units with serial number 0353, 0375, 0379 and higher, 1MB on all other units); for example, about 30 minutes for 3 channels at 100sps and 2MB RAM.

[Table 2-2](#) shows an overview of the differences between Communications mode and Buffered mode:

Table 2-2 Communications mode versus buffered mode

Mode	Web server	Data	Download data?	Stream data?	Power consumption
Communications	Always on	Continuously written to the data Store	Yes	Yes	Highest The Controller is always on.
Buffered	Only on at the beginning of the Buffered mode cycle (until the UI times out or is shut down) or when you manually force it on	Buffered until the buffer is full and then written to the data Store	Yes You can start a download when the Web server is on (before the UI times out or before you shut down the display screen).	No	Lowest The Controller is only on when writing data to the Store.

2.4.1.1 Configuring the Running Mode

To configure the running mode of a Taurus

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

2. Select **General**.
3. Select **Communications** from the Taurus Running Mode list.
-OR-
Select **Buffered** from the Taurus Running Mode list.
4. Select **Apply**.
5. Select **Commit**.

2.5 Setting the UI Timeout

If you have not been actively using the Taurus user interface within a configured period of time, the UI will time out. When the UI times out, the display screen shuts off and, in Buffered mode, the Web server also shuts off.

[Table 2-3](#) shows what happens when the UI times out for each of the running modes. For more information on the running modes, see [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27.

Table 2-3 UI timeout impact on the running modes

Mode	Taurus display screen	Web server
Communications	Turns off	Stays on
Buffered	Turns off	Turns off



In Buffered mode, the Web server does not start again until you press the centre button on the Taurus and turn on the display screen. This means that you cannot communicate with the Taurus until you physically turn it on again or until you manually force the Web server to start up again by using the curl command line tool. For information on how to do this, see [Section 2.5.1 "Forcing the Web Server to Turn On \(Buffered Mode\)"](#) on page 29.

To set the UI timeout period

1. Click  and select **Configuration** from the main menu. (Web browser)
- OR-
- Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`. For more information, see [Section 2.3.1 "Logging In"](#) on page 24.

2. Select **General**.
3. Select the number of minutes from the UI Timeout list.
4. Select **Apply**.
5. Select **Commit**.



If you start a data download in Buffered mode, the Controller will run long enough to complete the download and ignore the configured UI timeout if necessary.

2.5.1 Forcing the Web Server to Turn On (Buffered Mode)

In Buffered mode, when the UI shuts down, the display screen shuts off and the Web server also shuts off. The Web server does not start again until you press the centre button on the Taurus and turn on the display screen. This means that you cannot communicate with the Taurus until you physically turn it on again.

If you cannot physically turn the Taurus back on, you can manually force the Web server to start up again by using the [curl](#) command line tool.

To remotely force the Web server to turn on

1. Download and install the curl command line tool.
You can download curl packages from the following location:
<http://curl.haxx.se/download/>

2. Open a command prompt and type the following:
`curl -d "" http://<ip address of your Taurus>/keypress`

3. Repeat step 2 until the command has been executed successfully.

You can write a script to repeatedly invoke this command until it is successful.



The `/keypress` URL is only available for a very small period of time (1 to 2 minutes) every Buffered mode cycle. The full cycle can be anywhere from 10 to 60 minutes depending on the sample rate.

4. Connect to your Taurus by typing the IP address into the Address bar of your browser.

2.6 Accessing the Taurus File System via FTP, Telnet, and SSH

You can access the Taurus file system via File Transfer Protocol (FTP), telnet, and Secure Shell (SSH; Taurus supports SSH-1 and SSH-2). SSH is included as of Taurus firmware version 2.x. Nanometrics does not provide technical support for use of these protocols. Procedure details will depend on the operating system, the client you are using, and your network set-up.

FTP and telnet are both cleartext protocols, so it is risky to use them across an unsecure network. Where security is an issue it is better to use SSH, which encrypts the entire session. Most UNIX/Linux systems include an SSH client. On Windows, you can install a client such as PuTTY (<http://www.chiark.greenend.org.uk/~sgtatham/putty/>). PuTTY includes other utilities such as PSFTP (a secure FTP utility).

The Taurus server uses the standard port number for each protocol (FTP port 21, SSH port 22, and telnet port 23).

2.6.1 Logging In as Root

To log in as root

- ▶ Log in with the following credentials:
 - ▶ User name = *root*
 - ▶ Password = *dolphin18*

2.6.1.1 Changing the Root Password

If you are logged in as the user `root`, you can change the root password using the `passwd` command.



If you change the root password and then forget the password, there is no way to recover it. You will no longer be able to log in to the Taurus file system.

Chapter 3

Monitoring and Maintaining a Taurus

3.1 Monitoring Taurus Operation

The Taurus includes the following methods for monitoring operation:

- ◆ The status LEDs provide a quick view of the current Taurus status ([Section 3.2 "Status LEDs"](#) on page 32).
- ◆ The Status page provides a link to the Status Details page, which contains multiple status bars that provide more detailed status information ([Section 3.3 "Viewing Status Information"](#) on page 35).
- ◆ Various pages show the current state of subsystems, such as SOH, Sensor, and Timing pages ([Section 3.3 "Viewing Status Information"](#) on page 35).
- ◆ SOH data is recorded for the external SOH channels and for internal SOH ([Section 3.3.2 "SOH Data"](#) on page 36).
- ◆ The system logs provide detailed operation history ([Section 3.3.3 "System Logs"](#) on page 36).
- ◆ Alert messages can be used to narrow down a search through system logs ([Section 3.3.4 "Alert Messages"](#) on page 37).
- ◆ The Data Availability pages show a summary of data availability and any gaps ([Section 3.3.5 "Data Availability Information"](#) on page 37).
- ◆ System configuration information includes current version information for Taurus hardware and software and a configuration audit trail with a record of all configuration changes since the Store was created ([Section 3.3.6 "System Configuration Information"](#) on page 38).

3.2 Status LEDs

The Taurus includes 4 status indicator LEDs:

- ♦ Two SuperLEDs to indicate overall unit status
 - One is located on the top panel and the other one is on the side panel (see [Figure 3-1 "SuperLED locations"](#) on page 33). They both indicate the same thing. The top panel SuperLED is visible when you use the keypad, the side panel SuperLED is useful for monitoring stacked Tauruses (see [Figure 3-2 "Stack of Tauruses"](#) on page 33).
- ♦ An Ethernet Status LED to indicate Ethernet connection status.
- ♦ A Media Status LED to indicate whether it is safe to remove or insert recording media.

3.2.1 SuperLEDs

[Table 3-1](#) describes the Taurus unit status indicated by the various SuperLED states. The SuperLED uses the following information as inputs:

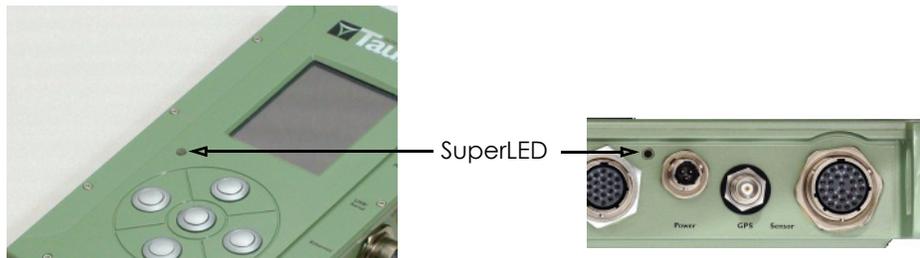
- ♦ Timing status
- ♦ Media door status
- ♦ Store status
- ♦ Sensor status
- ♦ Power Manager status
- ♦ Ethernet networking status
- ♦ Expected Trident connectivity
- ♦ Firmware validity
- ♦ Configuration status

Table 3-1 SuperLED states

State	Status
Off	The Taurus has no power.
Slow blink	The Controller is shut down.
Fast blink	Any of the following conditions: <ul style="list-style-type: none"> ♦ The Taurus is booting (if the power was just connected). ♦ The Controller is booting (for example, after a restart). ♦ The Controller is running. ♦ The Controller is writing data to the media in Buffered mode. The SuperLED colour will vary as Taurus initializes its status information during bootup.
Red (solid, ~5s)	The Taurus is starting to boot immediately after power is connected.

Table 3-1 SuperLED states (Continued)

State	Status
Blinking green	The Taurus meets all the conditions to capture data successfully. For example, the Taurus is digitizing, has recording media, is able to record to media and/or transmit data, has good power, has good timing, and the media door is closed.
Blinking yellow	The Taurus is determining the status of one or more subsystems. This is a temporary state that will change to either blinking green or blinking red. If the Store is reindexing, the SuperLED will be blinking yellow and some UI pages will not be available until reindexing is complete. reindexing might take a long time, depending on how much data are in the Store. Caution: You should not leave a Taurus that is in a Yellow state because it might change to a Red state. You can check the relevant status and configuration pages to identify the problem. You can also view the log files if more detail is required.
Blinking red	There is a fault or condition that prevents the unit from operating properly. You should investigate the problem. Possible problems: GPS/Timing status is not okay, missing recording media, a hardware or software problem, no Ethernet connection.

Figure 3-1 SuperLED locations**Figure 3-2** Stack of Tauruses

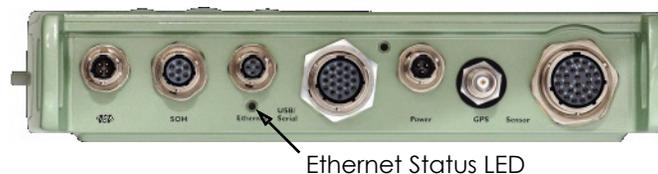
3.2.2 Ethernet Status LED

The Ethernet Status LED on the side panel ([Figure 3-3](#)) indicates the status of the Taurus Ethernet connection. [Table 3-2](#) describes the status indicated by the various Ethernet Status LED states.

Table 3-2 Ethernet status LED states

State	Ethernet status
Off	The Taurus has no power. -OR- The Controller is shut down.
Yellow (solid, ~8s)	The Taurus is starting to boot immediately after power is connected or the Controller is starting.
Fast blinking green	Networking is enabled and a link is established.
Slow blinking green	Networking is not enabled.
Blinking yellow	The Taurus is powering up and running diagnostics.
Blinking red	Networking is configured but there is no link.

Figure 3-3 Ethernet Status LED location

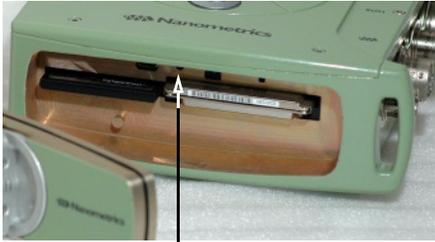


3.2.3 Media Status LED

The Media Status LED inside the media door (see [Figure 3-4 "Media Status LED location"](#) on page 35) indicates if it is safe to remove or insert recording media (either an IDE hard drive or a CF card or not (see [Section 9.2.1 "Replacing Recording Media"](#) on page 84). [Table 3-3](#) describes the status indicated by the various Media Status LED states.

Table 3-3 Media status LED states

State	Media status
Green	It is safe to remove or insert recording media because the Controller is shut down.
Solid yellow	The Controller will be turned on in 2 minutes because the buffer is full. Do not remove or insert recording media.
Fast blinking yellow	The Controller will be turned on in 30 seconds because the buffer is full. Do not remove or insert recording media.
Red	It is not safe to insert or remove recording media because the Controller is running. Caution: You must shut down the Controller before removing or inserting recording media. This does not stop the Digitizer or cause data gaps.

Figure 3-4 Media Status LED location

Media Status LED

3.3 Viewing Status Information

Several UI pages show current status information. See the relevant sections in [Appendix G "UI Pages"](#) for an overview of the information shown on each page:

- [Section G.1 "Status"](#) on page 138
- [Section G.3 "SOH"](#) on page 142
- [Section G.5 "Timing"](#) on page 145
- [Section G.6 "Store Tools"](#) on page 147

The SOH information shown on these pages is updated every 5 seconds, independent of the SOH Report Interval setting (see [Section 3.3.2 "SOH Data"](#) on page 36).

3.3.1 Status Bars

The status bar on the Status page is to help you interpret the SuperLED. The colour matches the colour of the SuperLED and a brief text label summarizes the problem.

- A bar with a green background indicates that everything is working properly.
- A bar with a yellow background and with text followed by a question mark indicates Taurus is acquiring status information. This is a temporary state that will change to either Green or Red.



You should not leave a Taurus that is in a Yellow state because it might change to a Red state. You can check the relevant status and configuration pages to identify the problem. You can also view the log files if more detail is required.

- A status bar with a red background indicates an error condition that must be investigated and fixed.

You can check the relevant status and configuration pages to identify the problem. You can also view the log files if more detail is required.

The Status Details page is displayed when you select the text on the status bar on the Status page. The Status Details page contains multiple status bars that provide more detailed status information.

Some of the status bars also have links to additional pages (such as Timing, Sensor, and Store Tools) that show additional configuration or status information that can help you identify problems. For detailed information about each status bar colour, see [Table G-2 "Status details page overview"](#) on page 139.

3.3.2 SOH Data

SOH data is recorded to the Store for the 4 External SOH channels and for internal SOH.

You can download SOH data to .csv files. For more information, see [Section 10.4 "Extracting State of Health Data"](#) on page 95.

3.3.2.1 Setting the SOH Report Interval

You can set the SOH report interval. This setting applies to the 4 External SOH channels and some of the internal SOH. The internal SOH that use this setting include the types listed in the table in [step 3 of Section 10.4 "Extracting State of Health Data"](#) on page 95, except for the types in the row labelled PowerPC, which are not configurable.

To set the SOH report interval

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

2. Select **General**.
3. Type a number between 5 and 3600 in the SOH Report Interval box.
The default setting is 60 seconds.
4. Select **Apply**.
5. Select **Commit**.



The SOH information shown on the UI pages is updated every 5 seconds, independent of the SOH Report Interval setting.

3.3.3 System Logs

The Taurus system logs provide operation messages to the configured levels of detail. System logs are recorded to the Store.

You can download the system logs to a file and then view the information in any text editor. See [Section 10.5 "Extracting System Logs"](#) on page 98 for information on downloading the system logs.

3.3.3.1 Setting the Log Verbosity

You can set the level of detail for the Apollo and ARM system logs (the DSP log verbosity is not configurable).

To set the logging level

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

2. Select **General**.
3. Select the log verbosity level for both the Apollo (Controller and User Interface) and the ARM (Digitizer) from the lists.

Logging level	Description
Info	All errors, warnings, and minimal system status information
Verbose	All error, warnings, and more detailed system status information
Debug	All errors, warnings, and extensive system status information

Note: You should only select Debug as the logging level if you were instructed to do so by Nanometrics Technical Support.

4. Select **Apply**.
5. Select **Commit**.

3.3.4 Alert Messages

The Alerts pages show a list of occurrences such as start-ups, shut downs, and major errors. Alert messages include a time stamp and a brief description. You can use these message time stamps as reference points for searching through system logs for events that generated an alert.

3.3.5 Data Availability Information

The Data Availability pages provide an overview of availability including information about gaps. See [Section G.4 "Data Availability"](#) on page 143 for an overview of what information is shown and [Chapter 10 "Viewing and Retrieving Data"](#) for the data download procedures.

3.3.6 System Configuration Information

The Taurus maintains an audit trail of configuration changes made since the Store was created. For more information, see [Section 5.4 "Viewing Configuration Change History"](#) on page 52.

- ▶ You can download the audit trail to a text file to view as a reference. See [Section 10.6 "Extracting the Configuration Audit Trail"](#) on page 98.

Version information of Taurus hardware and software components is shown on the System Info page.

- ▶ You can download the version information to a text file. See [Section 10.7 "Downloading Taurus System Information"](#) on page 99.

3.4 Maintaining a Taurus

The Taurus hardware does not require scheduled maintenance. Use the current status information and the system logs to assist you with troubleshooting.

- ▶ If after troubleshooting, it is determined that the Taurus requires repair or if you have any questions, contact Nanometrics Technical Support (see [Section "Contacting Technical Support"](#) on page 175).



Before you return a unit to Nanometrics for repair, contact Nanometrics Technical Support to obtain an RMA number.

- ▶ New firmware uploads are available periodically. See [Appendix F "Firmware Upgrade Procedures."](#)

Part 2

Powering and Configuring a Taurus

- ◆ Powering a Taurus
- ◆ Changing Configuration Settings
- ◆ Configuring Taurus Communications
- ◆ Configuring the Digitizer
- ◆ Controlling and Configuring Sensors

Chapter 4

Powering a Taurus

4.1 Taurus Power Consumption

Power consumption of the Taurus varies with factors such as the operating mode and GPS receiver duty cycle. (See [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27 and [Section A.13 "Power"](#) on page 113 for specifications).

- ◆ In Buffered mode, the Taurus will write data to the Store on the recording media at approximately 30 minute intervals (for 3 channels at 100 sps). The average power consumption will typically be 750 mW when using CompactFlash and with the GPS Duty Cycle mode configured to Automatic. Instantaneous power consumption is higher than 750 mW for the minute or two when the data in the Digitizer buffer is being written to the Store. Power consumption will be higher with a higher sample rate since the buffer fills more frequently. Power consumption will be correspondingly lower for lower sample rates.
- ◆ In Communications mode, the Controller is running continuously. This consumes more power (about 2.3 W when CompactFlash is used) than Buffered mode.
- ◆ The highest power consumption occurs when the Taurus display screen is on and all systems are running (about 3.3 W).

Power consumption as discussed above refers to the Taurus only. Power consumption of peripheral devices, such as the sensor, or devices connected to the NMXbus, serial port, or the External SOH, is in addition to these stated averages.

4.2 Grounding a Taurus Installation

The most appropriate grounding plan will depend on your application and the installation environment. This section outlines some general information you can take into account when planning grounding for a Taurus installation. For more information, see [Appendix C “Seismometer-Taurus Interconnection.”](#)

[Figure 4-1](#) shows the Taurus ground architecture and [Figure 4-2](#) shows where to connect a grounding lug to the Taurus (using an M4 x 5 screw).

Figure 4-1 Taurus ground distribution and architecture

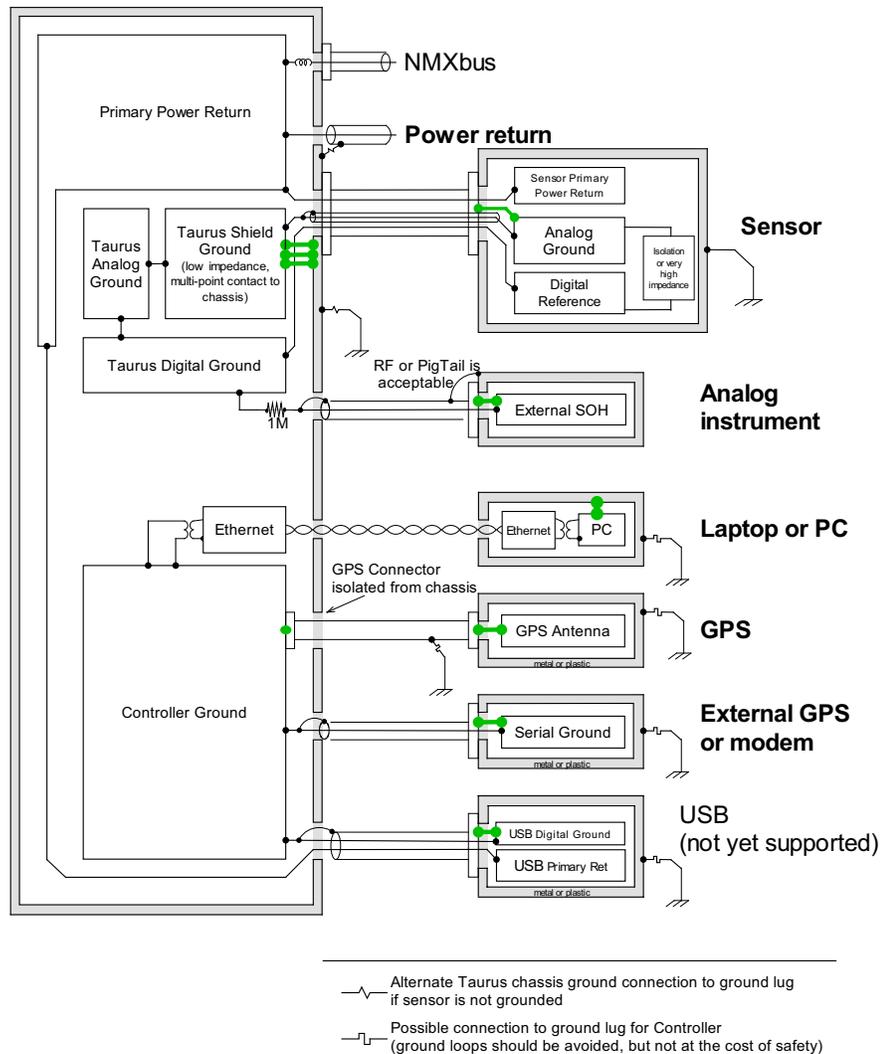


Figure 4-2 Hole for grounding lug screw

The Taurus has chassis ground, analog ground, digital ground, and primary (input power) return. Primary power return is completely isolated from chassis, analog, and digital ground. Sensor power is connected directly to the input power and is thus isolated from digital and analog ground. Chassis (case) ground is connected to the analog ground of the Digitizer subsystem. There is a single point connection from analog ground to the Digitizer subsystem digital ground. The Taurus Controller subsystem is isolated from the Digitizer and has its own Controller ground, which is used for the Serial and USB interfaces. For sensor cables, the chassis ground should be connected to the outer shield of the cable which is connected to the chassis of the sensor. The channel grounds are connected to the channel twisted pair shield. The control lines use digital ground and there must be a digital ground connection to the sensor. Sensor power return is connected to primary ground.

4.2.1 General Considerations

- ♦ Power – The Taurus power connector has 3 pins to allow the Taurus to conform to the site grounding system. You can connect the power return pin and ground, but combining grounding and power return in the same conductor limits the site grounding options. The recommended practice is to establish a single ground point for the station and ground everything to that point, which minimizes the chances of ground loops and signal noise created by the power system.
- ♦ Peripheral power – The Taurus provides primary power to attached peripheral devices via the Sensor, Serial, and NMXbus connectors. This power is switched to allow devices to be controlled by the user through the Taurus. The Taurus monitors for over-current conditions and will automatically switch off power to a peripheral if excessive current or a short is detected. See [Section A.13 "Power"](#) on page 113 for the typical current limit threshold of each peripheral power. Peripheral power is otherwise unregulated: The voltage provided to the Taurus is passed on to the attached peripherals. The current demand of each attached peripheral and the consequent voltage drop through the Taurus and peripheral cables should be taken into consideration when designing the power system to ensure that sufficient voltage is supplied to each peripheral.

- **Sensor** – The voltage drop through the Taurus in a typical 12 V system is $(1.0 * \text{peak current draw of the sensor}) + 100 \text{ mV}$. Add to that the voltage drop in the Taurus power cable ($\text{power cable resistance in ohms} * \text{peak current of the Taurus and all peripherals}$) and the sensor cable ($\text{sensor cable resistance in ohms} * \text{peak current of the sensor}$) to ensure that the total voltage drop between the Taurus power supply and the sensor does not cause the voltage at the sensor to fall below its required operating voltage. Solutions to problems of excessive voltage drop include heavier gauge cables, shorter cables, and higher voltage power supplies (which lowers the current consumption).

For example, a 12V system designed to operate down to 10.8V, with a short heavy gauge power cable and a 10m 24 gauge sensor cable (1.75Ω) operating a sensor with a peak current draw of 500mA, could see a voltage drop of $1.0 * 0.500 + 0.100 + 1.75 * 0.500 = 1.425\text{V}$. When the battery dips to 10.8V, peak current could cause the voltage at the sensor to drop to $10.8 - 1.425 = 9.375\text{V}$.

- **Serial** – Similar considerations apply, except that the calculation for net voltage drop in the Taurus is $(0.5 * \text{peak current draw of the peripheral}) + 100 \text{ mV}$.
- **NMXbus** – Similar considerations apply, except that the calculation for net voltage drop in the Taurus is $(0.5 * \text{peak current draw of the peripheral}) + 100\text{mV}$.
- ♦ **External SOH** – When there is a negative input voltage across External SOH values (pins A-G, for example) and if ground is connected to negative on the voltage supply, then an incorrect value appears for SOH. Ensure ground is floating from negative to prevent this error.
- ♦ **GPS antenna** – Do not short the GPS connector to the Taurus chassis as this might introduce a ground loop (for example, if the optional metal dust caps are installed, keep any loose caps away from the GPS connector).

The GPS antenna is on digital ground which has a single point connection to analog ground and analog ground is connected to chassis ground. The GPS Terminal Node Controller (TNC) connector is fully isolated from the chassis and therefore is isolated from chassis ground. The purpose of this scheme is to avoid a ground loop from digital ground to chassis to analog ground. Accidental momentary connection to the chassis is not a problem, but a permanent connection might create ground loops. Ideally, the GPS antenna is isolated from ground and, in most cases, this is fine because the antenna cable is short.

In configurations that have long GPS cables and lightning protection, an overall system design approach must be taken which balances the grounding requirements with the protection requirements. This approach requires an understanding of the Taurus grounding, the sensor grounding, power supply grounding, and local site grounding.

4.3 Powering a Taurus

See these sections for related information:

- ♦ [Section A.13 “Power”](#) on page 113 for Taurus power specifications.
- ♦ [Section 4.2 “Grounding a Taurus Installation”](#) on page 42 and [Appendix C “Seismometer-Taurus Interconnection”](#) for grounding information.
- ♦ [Section 2.6 “Accessing the Taurus File System via FTP, Telnet, and SSH”](#) on page 30 for Taurus start-up definitions and options.
- ♦ [Section “To configure power supply settings”](#) on page 47 for power manager configuration options.
- ♦ [Section 8.2 “Controlling Sensors”](#) on page 70 for turning sensor power on and off via the Taurus UI.



It is recommended that you use the Shutdown option to shut down the Controller before disconnecting the power. This will preserve data presently cached in the buffer and will allow the data Store to close gracefully. For more information, see [Section 2.2.2 “Shutting Down the Controller”](#) on page 22.

4.3.1 Choosing a Power Supply and Cable

Choose an appropriate power supply for your application. See [Section A.13 “Power”](#) on page 113 for the Taurus power specifications.

- ▶ Purchase a power cable.

-OR-

Build a power cable using a power connector from the optional Taurus Connector Kit (part number 15170) or equivalent (see [Appendix B “Connector Pinouts”](#)).

4.3.2 Powering Up a Taurus

1. Connect the Taurus to an appropriate 9 to 36V DC power supply (see [Chapter 4 “Powering a Taurus”](#)).

The Taurus will start booting up and finish in 2 to 3 minutes. Progress is indicated by the LED colour and blink patterns (see [Section 3.2 “Status LEDs”](#) on page 32) and the boot progress screen (see [Section 2.1.2 “Using a Web Browser”](#) on page 18).

2. Press and hold the centre key on the keypad for about 1 second to turn on the display screen (see [Section Figure 2-1 “Taurus keypad functions”](#) on page 17).

It will take about 10 to 15 seconds for the display screen to turn on and it opens to the Status page.



If the Store is reindexing while the Taurus is in Buffered mode, the Taurus will not respond to a key press until the reindexing is complete. In this case, you will see a yellow SuperLED and the display might take a very long time to start up after you press the centre key.

4.3.2.1 Bypassing the Power Supply Threshold Settings on Start-Up

If the power supply voltage is not within the configured range, the Taurus will not power up. If this happens, you can power up the Taurus by bypassing the power supply threshold settings on start-up.

To bypass the power supply threshold settings

- Connect the power to the Taurus while the media door is open.

If the media door is open when power is first connected, the battery voltage level checks are disabled and the Taurus is forced to start up.

Once the Taurus has started, you can reconfigure the voltage thresholds to the appropriate values for your power supply (see [Section 4.4 "Configuring Power Manager Settings"](#) on page 46).

4.3.3 Power Cycling a Taurus

The Shutdown option on the Shutdown page only shuts down the Controller. If you need to power cycle other subsystems or undo an applied configuration ([Section 5.1.2 "Undoing Applied Changes"](#) on page 50), you have to power cycle the Taurus:

To power cycle a Taurus

1. Press the top key of the Taurus display screen to open the main menu, press the bottom key to select **Shutdown**, and press the centre key.
2. Select **Shutdown**.
3. Wait until the SuperLED switches to a slow blinking pattern (0.5 seconds on, 5 seconds off), then disconnect the power cable.
4. Reconnect the power cable.

4.4 Configuring Power Manager Settings

The Configuration > Power Manager page provides options to configure power supply settings such as voltage thresholds and delays.

When the external power supply voltage falls below the Low Voltage Turn Off threshold and remains below this threshold for the Delay Low period, the Taurus powers off immediately. When the external supply voltage rises above the Low Voltage Turn On threshold, the Taurus powers up but not before 10 seconds has elapsed since the last shut down. Set the turn off value so as to properly protect the battery for your power supply and set the turn on value high enough to prevent the unit from prematurely turning on due to battery rebound. Voltage drops in long power supply cables should also be considered in determining these values.



If the supply voltage is lower than the configured Low Voltage Turn Off value or higher than the High Voltage Turn On value, the Taurus will not power up. You can bypass these voltage threshold settings on power up, see [Section 4.3.2.1 "Bypassing the Power Supply Threshold Settings on Start-Up"](#) on page 46.

When the external power supply voltage rises above the High Voltage Turn Off threshold and remains above this threshold for the Delay High period, the Taurus powers off immediately. When the external power supply voltage drops below the High Voltage Turn

On threshold, the Taurus powers up but not before 10 seconds has elapsed since the last shut down.

To configure power supply settings

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

2. Select **Power**.
3. Enter the appropriate values for your system.

See [Table H-21 "Power supply settings"](#) on page 164 for permissible values.

The default values are for 12 V lead-acid batteries and assume short power cables. To protect your equipment, confirm the appropriate values for your power system and the maximum voltage tolerance of your sensor before setting these values.

4. Select **Apply**.
5. Select **Commit**.

Chapter 5

Changing Configuration Settings

5.1 Making Configuration Changes

To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: tech or central.

To change the configuration of a Taurus

1. Click  and select **Configuration** from the main menu. (Web browser)
-OR-
Press the keys to open the main menu and select the **Configuration** page. (display screen)
2. If required, enter a user name and password.
For more information, see [Section 2.3.1 "Logging In"](#) on page 24.
3. If you do not have any Trident 305 Digitizers connected to the Taurus, go to [step 4](#).
-OR-
Select the Taurus or Trident 305 you want to configure and go to [step 4](#).
4. Select the configuration category that contains the settings you want to change.

Category	For an overview of the settings, see
General	Section H.2 "General" on page 149
Data Streaming	Section H.4 "Data Streaming" on page 152
Data Retrieval	Section H.6 "Data Retrieval" on page 156
Digitizer	Section H.8 "Digitizer" on page 158
Sensor Library	Section H.10 "Sensor Library" on page 166
Communications	Section H.3 "Communications" on page 150
Security	Section H.5 "Security" on page 156
Calibration	Section H.7 "Calibration" on page 157
Power Manager	Section H.9 "Power Manager" on page 164

5. Change the value of one or more of the settings as required.
You can select **Reset** to undo any changes that have not been applied.

6. Select **Apply** to apply your changes.

If necessary, you can undo the changes you applied. For information on how to do this, see [Section 5.1.2 “Undoing Applied Changes”](#) on page 50.

7. Select **Commit** to permanently save the changes you made.



Any changes not committed are lost when the Controller is shutdown or reboots. For more information, see [Section 2.2.2 “Shutting Down the Controller”](#) on page 22.

5.1.1 Configuration Pages Tips

- ♦ The **Apply**, **Reset**, and **Commit** buttons affect all configuration pages, not just the page on which the **Apply**, **Reset**, or **Commit** button was selected.
- ♦ Always select the **Previous** button to navigate back through configuration pages to preserve unapplied changes. If you use the Web browser's Back button, unapplied configuration changes are discarded.
- ♦ You should only use one browser session at a time for configuration changes. For example, if you are running two browsers simultaneously (an external Web browser and the internal browser on the Taurus) and performing configuration changes on both, you must select the **Reset** button on the configuration page each time you switch from one browser to the other.

5.1.2 Undoing Applied Changes

To undo applied changes, you can

- Manually apply the reverse of the changes that were made

-OR-

Restart the subsystem where the applied changes are stored

To undo changes applied to	You have to
Data Retrieval page Communications page Security page Sensor Library page (all sensors except the active sensor) UI Timeout (General page) Apollo Log Verbosity (General page)	<ol style="list-style-type: none"> 1. Click  and select Shutdown from the main menu. (Web browser) -OR- Press the top key to open the main menu, press the bottom key to select Shutdown, and press the centre key. (display screen) 2. Select Restart.

To undo changes applied to	You have to
Calibration page	<ol style="list-style-type: none"> 1. Press the top key to open the main menu, press the bottom key to select Shutdown, and press the centre key. 2. Wait until the SuperLED switches to a slow blink pattern (0.5s on, 5s off), then disconnect the power cable. 3. Reconnect the power cable.
Digitizer page	
Power Manager page	
Sensor Library page (active sensor)	
Timing page	
Taurus Running Mode (General page)	
SOH Report Interval (General page)	
ARM Log Verbosity	

5.2 Downloading a Configuration File

You can download all of the configuration settings of a Taurus and save them as a file. You can do this for the default configuration settings but also for custom configurations settings. You can then upload the configuration file and apply the settings to any Taurus.

1. Click  and select **Configuration** from the main menu. (Web browser)
2. Click **Download**.
3. Save the .ttl file.

The format of the Taurus configuration file is Terse RDF Triple Language (Turtle), which is a syntax for the Resource Description Framework (RDF). For information on Turtle, see <http://www.ildt.bris.ac.uk/discovery/2004/01/turtle>. For information on RDF, see <http://www.w3.org/RDF>.

5.3 Uploading a Configuration File

Valid configuration files can be uploaded to a Taurus to replace the existing configuration settings (for example, a configuration file downloaded from another Taurus). The configuration settings are applied automatically when you upload the configuration file.



You must have the configured recording medium installed in the Taurus before you can upload a configuration.

1. Click  and select **Configuration** from the main menu. (Web browser)
2. Click **Browse**, find the Taurus configuration file you want to upload (.ttl), and click **Open**.

The format of the Taurus configuration file is Terse RDF Triple Language (Turtle), which is a syntax for the Resource Description Framework (RDF). For information on Turtle, see <http://www.ildt.bris.ac.uk/discovery/2004/01/turtle>. For information on RDF, see <http://www.w3.org/RDF>.

3. Click **Upload**.

The configuration settings defined in the configuration file are applied automatically after the file has been uploaded. See [Section 5.1.2 "Undoing Applied Changes"](#) on page 50 if you want to revert to the previous configuration settings.

4. If you want to make the uploaded configuration settings permanent, click **Commit**.
5. Click  and click **Shutdown** from the main menu.

5.4 Viewing Configuration Change History

The Taurus maintains an audit trail of all configuration changes since the Store was created. You can download this system configuration audit trail from a Store to a file in text format.

You can view the text file to determine the exact state of the configuration for the Taurus at any point since the Store was created. It contains the configuration data and metadata, and an audit trail event trigger.

- ♦ For information on how to do this, see [Section 10.6 "Extracting the Configuration Audit Trail"](#) on page 98.

Chapter 6

Configuring Taurus Communications

6.1 Taurus Networking

You can configure a Taurus for network access via an IP connection over either an Ethernet connection or serial port (SLIP or PPP). The Taurus is accessible while it is in Communications mode or before the UI shuts down in Buffered mode (see [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27). The network configuration options are on the Configuration > Communications pages.



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`. For more information, see [Section 2.3.1 "Logging In"](#) on page 24.

6.1.1 Packet Routing

When packets are destined to a location outside of an immediate interface (more than a single hop), a default route is required. A Taurus can have multiple interfaces configured, the Default Interface setting specifies which remote address should be used as the gateway and all packets that are not on an immediate interface will be sent to that gateway:

- ♦ Ethernet – The gateway used is the one obtained from the settings specified on the Configuration > Communications > Ethernet page.
- ♦ Serial Port 1 – The gateway used is the Remote IP Address configured on the Configuration > Communications > Serial Port 1 pages.

To set the packet routing default interface

1. Click  and select **Configuration** from the main menu.
-OR-
Press the keys to open the main menu and select the **Configuration** page.
2. Select **Communications**.
3. Select the default interface from the list.
4. Select **Apply**.
5. Select **Commit**.

6.2 Communications over Ethernet

The Taurus provides standard modes for searching for an Ethernet LAN interface. These include DHCP, Link-Local, and Static IP. There is also an option for no Ethernet.

- ▶ Use the supplied Ethernet cable (15228) or equivalent to connect the Taurus to your LAN.

6.2.1 Configuring Ethernet Settings

To configure the Ethernet settings for a Taurus

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)

2. Select **Communications**.
3. Ensure the Default Interface is set to Ethernet.
4. Select the **Ethernet** link.
5. Select an Ethernet mode from the list.

Mode	Description
DHCP	<p>The Taurus searches for a DHCP server to obtain a network address.</p> <p>If a DHCP server is not found, the Taurus will use Link-Local protocol to acquire an available IP address.</p> <p>Note: If DHCP is set as the Ethernet mode, the IP address of the Taurus could change whenever the Taurus reboots (such as after a firmware upgrade).</p>
Link-Local	<p>The Taurus uses trial-and-error testing of the LAN for address conflicts to acquire an available IP address in the Link-Local address space of 169.254.0.0/16.</p>
Static IP	<p>The Taurus uses the Ethernet Static IP Address, Ethernet Static Subnet Mask and Static Default Gateway settings to define its Ethernet interface:</p> <ul style="list-style-type: none"> • Ethernet Static IP Address – The IP address for the Taurus in the selected network. • Ethernet Static Subnet Mask – Identifies which portion of the IP address is the network ID and which is the host ID. • Static Default Gateway – The IP address of the gateway device for remote network visibility.
None	<p>The Ethernet interface is disabled.</p> <p>This will conserve a small amount of power but will force you to access the Taurus via the display screen and keypad. (This setting is not associated with serial configuration in any way.)</p>

6. Select **Apply**.
7. Select **Commit**.

6.3 Communications over Serial Ports

Taurus provides one serial port that can be configured to use SLIP or PPP for link control and establishment, with a further option to use TDMA on a SLIP link. The default configuration setting for the port is 9600bps.

Serial Port 1 is a full 9-pin RS232 serial port designed for communication with a computer via a direct connection. Configuration options are on the Configuration > Communications > Serial Port 1 pages.

Table 6-1 Serial port protocols

Protocol	Description
Serial Line IP (SLIP)	A simple IP over serial protocol with very little overhead. The Taurus uses a 1500 byte frame size. Compressed SLIP (CSLIP) – SLIP with TCP/IP header compression. This will decrease the TCP/IP header from 40 bytes to 7 bytes but has no effect on the 28-byte UDP/IP headers.
Point to Point Protocol (PPP)	A more advanced IP over serial protocol that is used in modem communications. This mode can be used to test streaming over PPP by connecting directly from a computer. However, Taurus is only listening for connect requests, it does not attempt to connect to a PPP server. Typically, you would use SLIP for a direct connection. A Taurus automatically provides a PPP client with its local and remote IP addresses for the PPP connection.
Unused	The serial port is not used.

6.3.1 Flow Control

When streaming data, a Taurus will automatically reduce the rate at which NP packets are transmitted based on the configured speed of Serial Port 1. The throttle rate is set to allow for other TCP traffic to get across the link and to account for PPP overhead.

6.3.1.1 Bandwidth Requirement

Even with flow control, the serial link has bandwidth limits which, if exceeded, might affect data availability. When streaming data over a serial port, the following condition must be true:

$$\begin{aligned} \text{Number_bytes_required_to_be_sent} &< \text{Maximum_number_bytes_that_can_be_sent} \\ \text{Maximum_number_bytes_that_can_be_sent} &= \text{SerialPortSpeed} \times 0.90 / 10 \\ \text{Number_bytes_required_to_be_sent} &= \text{OutputChannels} \times \text{SampleRate_Hz} \times \\ &\quad \text{BytesPerSample} \times \text{PacketOverhead} \\ \text{PacketOverhead} &= (51 + 64 \times \text{FramesPerPacket} + 28) / (60 \times \text{FramesPerPacket} - 8) \end{aligned}$$

If this condition is violated, buffers will temporarily allow data streaming without data loss but a data delay might be noticed.



The packet overhead is the combined overhead of the Steim (1), NP, and UDP/IP overheads.



If you are using TDMA over a serial port, remember that the maximum number of bytes that can be sent will be limited additionally by the size of the Taurus TDMA slot.

6.3.2 Configuring a SLIP Direct Connection

The Taurus supports a direct SLIP connection via a serial communication cable or transparent serial modem. This section provides the procedure for configuring the Taurus for a SLIP connection and an example for Microsoft Windows XP.

To configure a SLIP connection for a Taurus

1. Click  and select **Configuration** from the main menu. (Web browser)
-OR-
Press the keys to open the main menu and select the **Configuration** page. (display screen)
2. Select **Communications**.
3. Select the **Serial Port 1** link.
4. Select **SLIP** from the Mode list.
5. Select a link speed from the Speed list.
6. Set the Local IP to the IP address of the local SLIP interface.
7. Set Remote IP to the IP address of the remote SLIP interface.



Make sure that the Local IP and the Remote IP are in the same /24 subnet. For example, if the local IP is set as 1.2.3.XX, the remote IP should also be in the same subnet, such as 1.2.3.YY.

The subnet of the SLIP endpoints cannot be the same as the subnet of the Ethernet connection of your Taurus. We recommend that you use a private network address pair that does not match the Ethernet subnet of your Taurus or workstation computer. If you are using the SLIP/PPP connection on your Taurus for an Internet-bound connection, you should use the endpoint addresses specified by your network administrator.

8. Select the **SLIP** link.
9. Select **SLIP** from the Protocol list.
10. Select **Apply**.
11. Select **Commit**.

6.3.2.1 Example SLIP Connection Configuration (Windows)

This example procedure is for a direct cable connection.

1. Connect the hardware and remove potentially conflicting settings:
 - a) Build a serial cable and connect it to the working COM port (normally COM1 of your computer).
 For example, use a DB-9 connector and the connector from the optional Taurus Connector Kit (part number 15170). For more information, see [Appendix B "Connector Pinouts."](#)
 If your link drops frequently, use a serial cable with a computer serial connector (DB-9) with pins 7,8 (RTS, CTS) shorted and pins 1,4,6 (CD, DTR, DSR) shorted. Some motherboards (computer hardware) require a full loop back serial cable to maintain a connection.
 - b) Close all serial port applications (such as Hyper terminal, Teraterm).
 - c) Ensure all modems are removed from the Modems tab (Control Panel > Phone and Modem Options) before continuing. Other modem drivers might confuse Windows XP enough to refuse connection.
2. Go to Start > Control Panel > Phone and Modem Options.
3. Click the **Modems** tab.
4. Select **Communications cable between two computers** and click **Properties**.



If necessary, you can add Communications cable between two computers to the list.

 1. Click **Add**.
 2. Select **Don't detect my modem** and Click **Next**.
 3. Select **Communications cable between two computers** and Click **Next**.
 4. Select **COM Port** and click **Next**.
 5. Click **Finish**.
5. Click the **Modem** tab and the set maximum port speed to 57600.
6. Click the **Advanced** tab.
7. Click **Change Default Preferences** and set the port speed and flow control.
 - a) Set port speed to 57600.
 - b) Set Flow control to none.
 - c) Click **OK**.
8. Click **OK** to return to the Phone and Modem Options.
9. Click **OK** to return to Control Panel.

10. Create the new network connection:
 - a) Go to Start > Connect to > Show all connections and select **Make new connection**.
-OR-
Go to Control Panel > Network Connections > Make new connection.
 - b) Click **Next**.
 - c) Select **Set up an advanced connection** and click **Next**.
 - d) Select **Connect directly to another computer** and click **Next**.
 - e) Select **Guest** and click **Next**.
 - f) Type a name in the Computer Name box and click **Next**.
 - g) Select **Communications cable between two computers (COMx)** and click **Next**.
 - h) Select **Anyone's use** and click **Next**.
 - i) Click **Finish**.
 - j) In the *Connect ComputerName* dialog box, ignore User name and Password.
 - k) Click **Properties**.
 - l) Select Communications cable between two computers, click **Configure**, and set the following:
 - i. Set maximum speed to 57600.
 - ii. Ensure all check boxes are cleared.
 - iii. Click **OK**.
 - m) Click the **Options** tab and clear the check box **Prompt for name and password**.
 - n) Click the **Networking** tab and select the SLIP connection.
 - o) Clear all check boxes except TCP/IP and QoS Packet Scheduler.
 - p) Double-click **TCP/IP** and select **Use the following IP address**.
 - q) Set the IP address to the Remote IP address configured in the Taurus.
 - r) Click **Advanced** and set the following:
 - i. Clear the check box **Use IP header compression**.
 - ii. Set frame size to 1500.
 - s) Click **OK**.
 - t) Click **OK** on TCP/IP properties.
 - u) Click **OK** on *ComputerName* Properties.
 - v) Ensure the Taurus has been powered up and Serial 1 is connected to the COM port.
The message "All devices are connected" will appear briefly and the connection icon will show up immediately in the system tray.
11. Test the connection by pinging the Local IP address configured on Taurus from a command prompt.

6.3.3 Configuring a CSLIP Connection

CSLIP provides minor amounts of compression to the link.

6.3.3.1 Taurus Configuration for CSLIP Connection

To use CSLIP, follow the steps for configuring a SLIP connection (see [To configure a SLIP connection for a Taurus](#) on page 56) with the following change:

- ▶ For step 9, set the protocol to CSLIP.

6.3.3.2 Windows XP Configuration for CSLIP Connection

1. Follow the steps described in the [Section 6.3.2.1 "Example SLIP Connection Configuration \(Windows\)"](#) on page 57.
2. Go to Control Panel > Network Connections and right-click the *ComputerName* connection.
3. Go to the Networking tab and double-click **Internet Protocol (TCP/IP)**.
4. Click **Advanced**.
5. Select the **Use IP Header Compression** check box.
6. Click **OK** until you have finished the steps of the wizard.

6.3.4 Configuring TDMA over SLIP

You can configure Serial Port 1 for TDMA over a SLIP link. The link typically would use a pair of transparent serial radio modems to communicate with a shared Nanometrics communications device.

If the Taurus system timing status is not good (status is not Green), data streaming is disabled until timing status is good again. (See the table row [Timing](#) on page 139 for a summary of timing statuses and indicators.)

While data streaming is disabled, HTTP access to the Taurus is still available. HTTP access might be erratic, depending on the number of collisions on the link due to any significant shift of the Taurus time slot.



For a network that uses a set of half-duplex links on different frequencies, it is recommended that you configure the radios for priority receive. For low bandwidth links, you can balance transmission efficiency for data transmission and retransmission requests by setting the respective slot proportions to 90% and 10%.

To configure TDMA for a Taurus

1. Click  and select **Configuration** from the main menu. (Web browser)
-OR-
Press the keys to open the main menu and select the **Configuration** page. (display screen)
2. Select **Communications**.
3. Ensure the Taurus is configured for a SLIP connection.
4. Select **Serial Port 1**.
5. Select the **TDMA** link.
6. Select the **Enable TDMA** check box.
7. Enter values for the following TDMA settings:

Setting	Description
Frame Length	<p>Enter a number between 1000 and 10000 milliseconds. The default setting is 4000.</p> <p>The TDMA frame length must be set to the same value for all devices sharing the link. This value should be compatible with the minimum slot size for this connection (Section 6.3.5 "Configuring a PPP Connection" on page 61).</p>
Slot Start [%]	<p>The Taurus TDMA slot start position as a percentage of the entire frame</p> <p>Enter an integer from 0 to 99.</p> <p>The default setting is 0.</p> <p>Note: The slot start plus slot duration must be less than or equal to 100.</p>
Slot Duration [%]	<p>The Taurus TDMA slot duration as a percentage of the entire frame</p> <p>Enter an integer from 1 to 99.</p> <p>The default setting is 80.</p> <p>Notes:</p> <ul style="list-style-type: none"> ♦ The slot start plus slot duration must be less than or equal to 100. ♦ The minimum slot size is determined by the largest frame that can be transmitted over the serial link. The minimum slot size is determined by the largest frame that can be transmitted over the serial link. The minimum slot size in milliseconds is defined as follows: $\text{minSlotSize} = \text{guardTime} + ((\text{MTU} \cdot \text{bitsPerCharacter} \cdot \text{paddingMargin} / \text{dataRate}) / 1000)$ <p>For example, with 35ms slot guard time (not configurable to other values in this release), a 530 byte Maximum Transmission Unit (MTU), 10 bits per character (8 data bits, 1 start, 1 stop, no parity), 10% byte stuffing margin, and 9600 bps; the minimum slot size would be as follows:</p> $\text{minimum slot size} = 35 + 530 \cdot 10 \cdot 1.1 / 9600 \cdot 1000 = 642\text{ms}$

8. Select **Apply**.
9. Select **Commit**.

6.3.5 Configuring a PPP Connection

A Taurus supports a mode to test streaming over PPP by connecting directly from a computer. However, a Taurus is only listening for connect requests, it does not attempt to connect to a PPP server. This section provides the procedure for configuring the Taurus for a PPP connection and an example configuration procedure for Windows XP. Typically, you would use SLIP for a direct connection ([Section 6.3.2 "Configuring a SLIP Direct Connection"](#) on page 56).

To configure a PPP connection for a Taurus

1. Connect the hardware and remove potentially conflicting settings:
 - a) Build a serial cable and connect it to the working COM port (normally COM1 of your computer).

For example, use a DB-9 connector and the connector from the optional Taurus Connector Kit (part number 15170). For more information, see [Appendix B "Connector Pinouts."](#)

If your link drops frequently, use a serial cable with a computer serial connector (DB-9) with pins 7,8 (RTS, CTS) shorted and pins 1,4,6 (CD, DTR, DSR) shorted. Some motherboards (computer hardware) require a full loop back serial cable to maintain a connection.
 - b) Close all serial port applications (such as Hyper terminal, Teraterm).
 - c) Ensure all modems are removed from the Modems tab (Control Panel > Phone and Modem Options) before continuing. Other modem drivers might confuse Windows XP enough to refuse connection.
2. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)
3. Select **Communications**.
4. Select **Serial Port 1**.
5. Select **PPP** from the Mode list.
6. Select a link speed from the Speed list.
7. Set the Local IP to the IP address of the local PPP interface.
8. Set the Remote IP to the IP address of the remote PPP interface.



Make sure that the Local IP and the Remote IP are in the same /24 subnet. For example, if the local IP is set as 1.2.3.XX, the remote IP should also be in the same subnet, such as 1.2.3.YY.

The subnet of the PPP endpoints cannot be the same as the subnet of the Ethernet connection of your Taurus. We recommend that you use a private network address pair that does not match the Ethernet subnet of your Taurus or workstation computer. If you are using the PPP connection on your Taurus for an Internet-bound connection, you should use the endpoint addresses specified by your network administrator.
9. Select **Apply**.
10. Select **Commit**.

6.3.5.1 Example PPP Connection Configuration (Windows)

This example procedure is for a direct cable connection.

1. Connect the hardware and remove potentially conflicting settings:
 - a) Build a serial cable and connect it to the working COM port (normally COM1 of your computer).

For example, use a DB-9 connector and the connector from the optional Taurus Connector Kit (part number 15170). For more information, see [Appendix B "Connector Pinouts."](#)

 - ▶ If your link drops frequently, use a serial cable with a computer serial connector (DB-9) with pins 7,8 (RTS, CTS) shorted and pins 1,4,6 (CD, DTR, DSR) shorted. Some motherboards (computer hardware) require a full loop back serial cable to maintain a connection.
 - b) Close all serial port applications (such as Hyper terminal, Teraterm).
 - c) Ensure all modems are removed from the Modems tab (Control Panel > Phone and Modem Options) before continuing. Other modem drivers might confuse Windows XP enough to refuse connection.
2. Go to Start > Control Panel > Phone and Modem Options.
3. Click the **Modems** tab.
4. Select **Communications cable between two computers** and click **Properties**.
5. Click the **Modem** tab and the set maximum port speed to 57600.
6. Click the **Advanced** tab.
7. Click **Change Default Preferences** and set the port speed and flow control.
 - a) Set port speed to 57600.
 - b) Set Flow control to none.
 - c) Click **OK**.
8. Click **OK** to return to the Phone and Modem Options.
9. Click **OK** to return to Control Panel.
10. Create a new network connection:
 - a) Go to Start > Connect to > Show all connections and select **Make new connection**.

-OR-

Go to Control Panel > Network Connections > Make new connection.
 - b) Click **Next**.
 - c) Select **Set up an advanced connection** and click **Next**.
 - d) Select **Connect directly to another computer** and click **Next**.
 - e) Select **Guest** and click **Next**.
 - f) Type a name in the Computer Name box and click **Next**.
 - g) Select **Communications cable between two computers (COMx)** and click **Next**.
 - h) Select **Anyone's use** and click **Next**.

- i) Click **Finish**.
- j) In the Connect *ComputerName* dialog box, ignore User name and Password.
- k) Click **Properties**.
- l) Select **Communications cable between two computers**, click **Configure**, and set the following:
 - i. Set maximum speed to 57600.
 - ii. Ensure all check boxes are cleared.
 - iii. Click **OK**.
- m) Click the **Options** tab and clear the check box **Prompt for name and password**.
- n) Click the **Networking** tab and select the PPP connection.
- o) Clear all components except TCP/IP and QoS Packet Scheduler.
- p) Double-click **TCP/IP** and select **Use the following IP address**.
- q) Set the IP address to the Remote IP address configured for the Taurus.
- r) Click **Advanced** and set the following:
 - i. Select the **Use default gateway on remote network** check box.
 - ii. Clear the check box **Use IP header compression**.
- s) Click **OK** three times.
- t) Ensure the Taurus has been powered up and Serial Port 1 is connected to the appropriate Windows COM port.
- u) Open Start > Control Panel > Network Connections and select *ComputerName* (for example, Taurus PPP).
- v) Enter the following in the Connect Taurus PPP dialog box:
 - i. Type `pppuser` in the User name box.
 - ii. Type `beaver16` in the Password box.
- w) Click **Connect**.

If it succeeds, a connection icon will appear in the system tray with the message "Taurus PPP is now connected".
- x) Test the connection by pinging the Local IP address configured on Taurus from a command prompt.

6.4 Data Streaming

You can stream time series data over either an Ethernet or a Serial Port 1 (SLIP/PPP) connection to a destination such as Apollo Server or a NAQSServer. For more information, see [Section 11.1 "Streaming Data in NP Format"](#) on page 101.

6.5 Discovery

A Taurus can be configured to send out small multicast, identification messages to other devices and applications running on the network, such as Apollo Project, Apollo Server, and Antares. Discovery is enabled by default but you can disable it if required.

To disable Discovery

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)

2. Select **Communications**.
3. Select the **Discovery** link.
4. Clear the **Enable Discovery** check box.
5. Select **Apply**.
6. Select **Commit**.

Chapter 7

Configuring the Digitizer

Digitizer settings are grouped into four categories on the Configuration > Digitizer page:

- Main Settings - See [Section H.8.1 "Main"](#) on page 159.
- [Timing Settings](#)
- Front End Settings - See [Section H.8.3 "Front End"](#) on page 161.
- [Trigger Settings](#)

7.1 Timing Settings

Set the Timing settings as appropriate for your site and application using the options on the Configuration > Digitizer > Timing page. For more information on Timing settings, see [Section H.8.2 "Timing"](#) on page 160.

7.1.1 Taurus Times

A Taurus derives its time frames from GPS time as described in [Table 7-1](#). The times shown on the various pages are updated whenever those page views refresh (typically every 5 seconds unless the refresh rate is reduced to compensate for a slow network link when using a browser).

Table 7-1 Taurus time definitions

Type	Description	Shown on Taurus UI
GPS Time	The GPS time provided by the GPS receiver. The Taurus has an algorithm that attempts to correct any time errors that the GPS receiver might have under certain conditions.	Not shown – used as the basis for the derived times described below.
System Clock	The current system time according to the Taurus Digitizer. The system clock is resynchronized to GPS Time when the GPS receiver is turned on. For more information, see Section 7.1.2 "System Clock Correction" on page 66.	Timing page > Timing tab > Report time
Time	The current time according to the Controller (see Section 2.2.1 "Starting the Controller" on page 21 for a description of the Controller). The Controller resynchronizes its time to the system clock continuously when it is running.	<ul style="list-style-type: none">• Status page > Time• SOH page > Time
Update Time	The system time when the GPS data (including the GPS time) was last updated.	Timing page > GPS Map tab > Update Time
Last Updated	The system time when the GPS receiver last updated the information for a specific satellite.	Timing page > GPS Satellites tab > Last Updated

7.1.2 System Clock Correction

The system clock is kept close to GPS Time when GPS is available. Even when the GPS receiver is duty cycled and the system clock is free running for awhile, the time error is regularly small enough so that it can be smoothly reduced to near-zero levels by running the clock slightly off-frequency until perfectly resynchronized. The time module is in Fine Lock if the time error (which is the difference between the system clock and GPS Time) remains small. If a time error develops that is larger than a preset limit, the time module goes into Coarse Lock which steers the clock back faster.

Large time errors might develop if the system clock is left free running without the GPS receiver active for a prolonged period of time. The magnitude of the error is dependent on the length of time the GPS was unlocked (or otherwise unavailable) and the stability of the ambient temperature of the Taurus. In these cases, the clock steering described above would take too long and a system clock correction is necessary. This eliminates a large part of the error instantly, after which the error can be driven small using the steering mechanism. The system clock correction introduces a discontinuity in the Taurus time frame because time appears to be “jumping” by a predefined amount.

7.1.2.1 System Clock Correction Options

There are three options for configuring how the Taurus will correct the system clock time: Discard Samples, Slow Coarse Lock, and No Alignment. You can set these options on the Configuration > Digitizer > Timing page. For more information on timing settings, see [Section H.8.2 “Timing”](#) on page 160.

[Table 7-2](#) provides a description of the three options and explains the advantages and disadvantages of each.

Table 7-2 System clock correction options

Option	Description	Advantages	Disadvantages
Discard Samples	A time correction is performed in a multiple of 100 μ s when the time error between the Taurus and GPS time exceeds 66.7 μ s. To preserve data quality, the FIR filters buffers are flushed of their samples and the FIR filtering is disabled for a few hardware samples, so that the first output sample occurs on a UTC aligned multiple of the output sample period.	<ul style="list-style-type: none"> ◆ All output samples are UTC aligned. ◆ Very low maximum time error (66.7μs) between the Taurus and GPS time. ◆ Very little time is spent in the coarse lock mode so that the time error between the Taurus and GPS time is brought under 1.25μs very quickly. 	<ul style="list-style-type: none"> ◆ Hardware samples are discarded during a time correction so the last sample before the time correction is not one sample period before the first sample afterwards. ◆ A gap in data slightly larger than the FIR filter period is introduced. For example, when sampling at 100Hz, the FIR filter period is 36254 hardware samples or 1.2084667 seconds. This results in gaps of 1.21 seconds.

Table 7-2 System clock correction options

Option	Description	Advantages	Disadvantages
Slow Coarse Lock	A time correction is performed in a multiple of the output sample period when the time error between the Taurus and GPS time is greater than 2/3 the output sample period. For example, for 100 samples per second, the time correction is performed in multiples of 10ms when the time error exceeds 6.67ms. Before digitizing has started, the time corrections are performed in multiples of 100 μ s to minimize the time error.	<ul style="list-style-type: none"> • All output samples are UTC aligned. • Fewer time corrections are performed in this mode than any other because the threshold is much higher. • No hardware samples are discarded during a time correction so that the last sample before the time correction is still exactly one sample period before the first sample afterwards. 	<ul style="list-style-type: none"> • Might require several hours in coarse lock mode to slowly correct some time errors, especially when using low sample rates. • Time errors of up to 6.66ms between the Taurus and GPS time might occur when sampling at 100Hz. • Might not be suitable on an NMXBus with multiple Tauruses where simultaneous sampling of all channels is required at all times.
No Alignment	A time correction is performed in a multiple of 100 μ s when the time error between the Taurus and GPS disciplined clock exceeds 66.7 μ s. When first starting to digitize, after powering on or after a reboot, the output samples are UTC aligned.	<ul style="list-style-type: none"> • Very low maximum time error (66.7μs) between the Taurus and GPS time. • Very little time is spent in the coarse lock mode so that time error between the Taurus and GPS time is brought under 1.25μs very quickly. • No hardware samples are discarded during a time correction, so that the last sample before the time correction is still exactly one sample period before the first sample afterwards. 	<ul style="list-style-type: none"> • UTC alignment is not preserved after a time correction, therefore the actual phase of the output samples in the output sample interval is not always the same. For example, when sampling at 100Hz after performing a time correction of -1.1ms, the first sample output in each second is time stamped as xx.0089 instead of xx.0000. • Not suitable for networks where simultaneous sampling is required.

7.1.2.2 System Clock Battery Backup

The Taurus system clock has a battery backup for power outages. The battery can hold its charge and keep the current system time for approximately three months. If you plug it back into a power source after three months, the Taurus will display the date as 1970 and the system clock battery will need to be recharged.

You can recharge the system clock battery by keeping the Taurus plugged into a power source. The battery will be fully recharged after 4 days. To acquire the current system time, you have to connect the GPS antenna to the Taurus. The Taurus will automatically acquire the current system time when it locks to the GPS.

7.2 Trigger Settings

Set the detector and filter settings as appropriate for your site and application using the options on the Configuration > Digitizer > Triggers pages. For more information on trigger settings, see [Section H.8.4 "Triggers"](#) on page 162.

The Taurus can be configured to detect events using a LTA/STA trigger algorithm on one or more of the 3 time series data channels. You can define a trigger algorithm for each channel and enable or disable trigger detection for any channel. Each time series channel is associated with the same detector type identifier: channel 1, detector 1; channel 2, detector 2; and channel 3, detector 3. Each channel will filter the data using the trigger band-pass input filter before passing data to the detector.

You can enable triggers for inactive channels (see the Output Channels setting) although there will not be any associated data for any triggers that are detected. This could be used to define event information for a Time Series By Event retrieval on a different Taurus.

- ▶ Ensure that DC is filtered out for trigger detection. If you do not have the DC Removal filter enabled for your seismic channels, you must include a high pass filter in the trigger input filter.
- ▶ The valid value ranges for some of the settings depend on the sample rate (see [Table H-19 "Input filter settings"](#) on page 163 and [Table H-20 "Detector settings"](#) on page 163).
- ▶ Ensure that the Trigger On Ratio and channel gain are configured to values that are not so high that they will prevent events from ever triggering. The Trigger On Ratio setting is on the Configuration > Digitizer > Triggers > Detector *n* page and channel gain is determined by the settings Input Range and Software Gain on the Configuration > Digitizer > Front End page.
- ▶ If you want to simulate an amplitude threshold trigger, you can use a short STA time constant and a long LTA time constant.



There are various external sources of information on defining trigger parameters in general. For example, the New Manual of Seismological Observatory Practice (IASPEI 2002) provides an excellent discussion of this topic.

7.2.1 Trigger Packets

The Taurus creates a trigger channel with a data packet for each trigger. You can extract the trigger data as SOH information to a `.csv` file ([Section 10.4 "Extracting State of Health Data"](#) on page 95). A trigger packet contains the following information:

- ◆ Trigger start time
- ◆ Trigger duration
- ◆ Channel and detector identification
- ◆ STA at trigger detection
- ◆ LTA at trigger detection

Chapter 8

Controlling and Configuring Sensors

8.1 Monitoring Sensor Operation

The Sensor page shows the following near real-time information about your sensor:

- ◆ The mass position of each component and the automatic mass centre voltage thresholds as configured on the Auto Mass Centring page. For more information, see [Section H.10.2 "Auto Mass Centring"](#) on page 167.



This information can also be extracted to an Environment SOH file (see [Section 10.4 "Extracting State of Health Data"](#) on page 95).

- ◆ For active sensors, an estimate of the sensor power consumption is shown on the Sensor page.

The estimated power consumption is accurate to about $\pm 15\%$ for sensors that draw more than 100 mW. A sensor status bar and a power status bar are also shown on the main Status page (see [Table G-2 "Status details page overview"](#) on page 139).

- ◆ System sensitivity is calculated using the sensor sensitivity value from the Configuration > Sensor Library > *Sensor Name* page and the input range and software gain from the Configuration > Digitizer > Front End page.

It is expressed in counts per unit of velocity or acceleration based on the sensitivity units defined on the Configuration > Sensor Library > *Sensor Name* page.

- ◆ A waveform of the sensor output for each channel with scaling options and waveform selection options as described in [Table G-3 "Waveform page overview"](#) on page 141.



If you have a Trident 305 connected to the Taurus, you can view sensor information for that Trident 305 by selecting the arrow  in the upper-right corner of the Sensor page and selecting the Trident 305 from the list.

8.2 Controlling Sensors

You can control some aspects of sensor operation using the buttons on the Sensor page:

- Not all buttons are visible for all sensor types.
- Specific sensor control line settings are required to make some of the buttons visible.

Buttons	Description	Sensor control line setting
 (Beside the sensor name at the top of screen)	Shows the settings for the sensor. You can change the settings of all custom sensors but you cannot change the settings of any of the default sensor configurations.	None required
	Centres all masses. Note: This option can only be used for sensors that support remote automatic mass centring (for example, Trillium 240 and Trillium 120PA).	One sensor control line must be set to Mass Centre.
	Locks all masses.	One sensor control line must be set to Mass Lock.
	Unlocks all masses.	One sensor control line must be set to Mass Unlock.
	Turns the sensor on and off. When you turn the sensor on, the Taurus supply voltage is passed through to the sensor power pin (see Appendix B "Connector Pinouts"). Note: For sensors that require regulated power, an appropriate DC/DC convertor must be built into the sensor cable.	None required
	Starts the calibration of the sensor. The sensor is calibrated based on the settings configured on the Configuration > Calibration page.	One or more sensor control lines must be set to Cal Enable.
	Stops the calibration of the sensor.	One or more sensor control lines must be set to Cal Enable.
 (Beside the Stop calibration button )	Shows the settings for the sensor calibration. You can change these settings as required.	One or more sensor control lines must be set to Cal Enable.

Buttons	Description	Sensor control line setting
	<p>Sets the sensor to Short Period mode.</p> <p>By default, the sensor is set to Long Period mode.</p> <p>Notes:</p> <p>When a sensor is in Short Period mode, the button changes to  and you can use it to put the sensor in Long Period mode.</p> <p>Before you manually centre the masses of a Trillium 40 seismometer or a Trillium 120P seismometer, you must set the sensor to Short Period mode.</p>	<p>One sensor control line must be set to one of the following:</p> <ul style="list-style-type: none"> • SP/LP On=SP • SP/LP On=LP
	<p>Sets the orientation of the sensor elements to UVW (raw axis output) mode. The calibration is run separately on each channel in this mode.</p> <p>By default, the sensor is set to XYZ mode.</p> <p>Note: When a sensor is in UVW mode, the button changes to  and you can use it to put the sensor in XYZ mode.</p>	<p>One sensor control line must be set to one of the following:</p> <ul style="list-style-type: none"> • XYZ/UVW On=XYZ • XYZ/UVW On=UVW

8.3 Configuring Sensors

The Taurus ships with default sensor configurations that you can use as the configuration for your sensors. These default sensor configurations are listed on the Sensor Library page (Configuration > Sensor Library):



A sensor configuration contains the mode, power, voltage, sensitivity, control line, and calibration settings for a sensor. You can select the blue, hyperlinked name of a sensor configuration to view its settings. You cannot edit the settings of any of the default sensor configurations but you can edit the settings of any custom sensor configurations or create a copy of one of the default sensor configurations and edit it. For more information, see [Section 8.3.1 "Using Existing Sensor Configurations"](#) on page 72.

The sensor configuration that is currently active is shown beside the name of the Taurus (or Trident) at the top of the Sensor Library page.



You can change the active sensor configuration by selecting a new sensor configuration from the list and selecting **Apply** and **Commit**. You can select, create, edit, and delete sensor configurations on the Configuration > Sensor Library pages.

8.3.1 Using Existing Sensor Configurations

The Taurus ships with default sensor configurations that you can use for your sensors. You can also create new sensor configurations and use those. For more information, see [Section 8.3.2 "Creating a New Sensor Configuration"](#) on page 72.

To use an existing sensor configuration

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

2. Select **Sensor Library**.
3. Select the sensor configuration you want to use from the list.



You can view the settings by selecting the name of a sensor configuration. For example, select [Default Trillium 40](#) to view the settings of the Default Trillium 40 sensor configuration.

4. Select **Apply**.
5. Select **Commit**.

8.3.2 Creating a New Sensor Configuration

You can create new sensor configurations by copying and editing existing sensor configurations.

To create a new sensor configuration

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)

2. Select **Sensor Library**.
3. Select the New Item button  to create a new sensor configuration.

-OR

Select the Copy button  to create a copy of an existing sensor configuration.



You can view the settings of a sensor configuration by selecting the name. For example, select [Default Trillium 40](#) to view the settings of the Default Trillium 40 sensor configuration.

4. Enter a new name and change the settings of the new sensor configuration.
5. Select **Apply**.
6. Select **Commit**.

8.3.3 Editing Custom Sensor Configurations

You can edit the settings of any custom sensor configuration you create. You cannot edit the settings of any of the default sensor configurations.

To edit a custom sensor configuration

1. Click  and select **Configuration** from the main menu. (Web browser)
-OR-
Press the keys to open the main menu and select the **Configuration** page. (display screen)
2. Select **Sensor Library**.
3. Select the name of the custom sensor configuration you want to edit.
4. Edit the following settings as required:

Setting	Description
Sensor Name	The name of the sensor configuration This is the name that appears on the Sensor Library page.
SP/LP Mode	The operating mode of the sensor: short period (SP) or long period (LP)
XYZ/UVW Mode	The orientation of the sensor elements: XYZ or UVW UVW indicates a triaxial seismometer. If you select UVW mode, the calibration will run separately on each channel.
Calibration Mode	The calibration signal mode: Voltage or Current Refer to your sensor manual for information on which signal mode you should choose.
Needs Power	Select this option if the sensor needs power (active sensors). Do not select it for passive sensors that never require power.
Sensitivity Units	Refer to your sensor manual for the appropriate value: V/(m/s) or V/(m/s/s).
Sensitivity Value	Refer to your sensor manual for this value.

5. Select **Apply**.

6. Select the **Sensor Control Lines** link and configure the following settings as required for the sensor:

Setting	Default setting
Assert (On) Level	The assert line level
Deassert (Off) Level	The deassert line level
Positive Voltage Level	+5V Note: The tolerance of these voltage levels is +/-10%.
Pulse Duration [s]	The control pulse duration in seconds
Control Line 1 (pin H)	XYZ/UVW On=UVW
Control Line 2 (pin W)	SP/LP On=SP
Control Line 3 (pin G)	Unused Deassert
Control Line 4 (pin Z)	Ch 1 Cal Enable Note: If you selected Current as the Calibration Mode (see step 4), this control line will not be available for any other configuration option. It will be reserved for calibration current return.
Control Line 5 (pin c)	Ch 2 Cal Enable Note: See note for Control line 4 (pin Z).
Control Line 6 (pin Y)	Ch 3 Cal Enable Note: See note for Control line 4 (pin Z).

7. If supported by your sensor, select the **Auto Mass Centring** link and configure the following settings:

Setting	Description
Red Threshold [V]	The minimum voltage level used to indicate that the mass position is out of range. Mass centring is initiated one minute after this level is crossed for any sensing element. The threshold range is from negative to positive, for example 1 indicates -1 to +1. Enter a number that is equal to or higher than 0.001 and greater than the yellow threshold (if used). The default setting is 1.000000. Note: If you use both the red and the yellow thresholds, ensure that you set the yellow threshold as the lower mass position limit and the red threshold as the higher mass position limit (red >= yellow).
Auto-Centre on Red	Select this option if you want the Taurus to initiate mass centring when the Red Threshold is crossed. By default, this option is not selected.
Yellow Threshold [V]	The minimum voltage level used to indicate that the mass position is marginal. Mass centring is initiated after the Yellow Holdoff Time has expired. The threshold range is from negative to positive: for example, 1 indicates -1 to +1. Enter a number that is equal to or higher than 0.001 and lower than the red threshold (if used). The default setting is 1.000000.

Setting	Description
Auto-Centre on Yellow	Select this option if you want the Taurus to initiate mass centring when the Yellow Holdoff Time expires. By default, this option is not selected.
Yellow Holdoff Time [h]	The number of hours the Taurus waits when any mass position voltage is higher than the yellow threshold but lower than the red threshold before initiating mass centring. Enter a number between 0.1 and 72.
Retries per Auto-Centre	The maximum number of attempts the Taurus makes to centre the masses. Enter an integer between 0 and 20. The default setting is 10.
Retry Interval [min]	The number of minutes the Taurus waits between trying to automatically centre the masses again. Enter an integer between 1 and 20. The default setting is 10.

8. Select **Apply**.
9. Select **Commit**

8.3.4 Deleting Sensor Configurations

You can delete custom sensor configurations if it is not being used as the active sensor configuration. You cannot delete any of the default sensor configurations.

To delete a sensor configuration

1. Click  and select **Configuration** from the main menu. (Web browser)
-OR-
Press the keys to open the main menu and select the **Configuration** page. (display screen)
2. Select **Sensor Library**.
3. Select the Delete button  next to the sensor configuration you want to delete.
4. Select **Apply**.
5. Select **Commit**

8.4 Configuring Sensor Calibration

You can configure the settings that are used to calibrate the sensor on the Configuration > Calibration page.



- (1) If you selected Current as the Calibration Mode (see step 4 of [Section 8.3.3 "Editing Custom Sensor Configurations"](#) on page 73), control lines 4, 5, and 6 will not be available for any other configuration option. They will be reserved for calibration current return.
- (2) If a sensor has one calibration enable line and multiple calibration signal inputs (for example, STS-2), you might have to reconfigure the calibration channel each time to calibrate a different channel, depending on the cable design.



To ensure that the sensor calibration is configured properly, the cable design should be taken into consideration.

To configure sensor calibration settings

1. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)

2. Select **Calibration**.



You can also select the Configure calibration button  on the Sensor page to view and edit the calibration settings.

3. Configure the following settings as required:

Setting	Description
Calibration Name	The name of the calibration This name appears in the configuration change history file that you can download. For more information, see Section 5.4 "Viewing Configuration Change History" on page 52.
Calibration Type	The type of calibration signal generated by the Taurus: Sine, Pulse, or PRB. The default setting is Sine.
Attenuation	The value used to attenuate the calibration signal. You can use attenuation to select the range when lower amplitude signals are desired. For example, a more accurate 5mV signal is generated by selecting attenuation of 1000 and amplitude 5V, rather than attenuation of 1 and amplitude 0.005V. The default setting is 1.

Setting	Description
Amplitude	<p>The amplitude of the calibration signal in volts or amperes</p> <p>The units depend on the configured Calibration Mode (Voltage or Current).</p> <p>You can enter a value up to 5.0V or 60mA. If taken as a single-ended output (for example, between pin N (SEN_CAL1+) and pin V (DGND), the calibration circuit can provide a signal with a maximum amplitude of 4.5V.</p> <p>The default setting is 0.1.</p> <p>Notes:</p> <ul style="list-style-type: none"> ♦ Ensure that you choose a value low enough that the signal will not clip. If you have configured the Calibration Mode as Voltage, ensure that you know the calibration coil resistance. ♦ See step 4 of Section 8.3.3 "Editing Custom Sensor Configurations" on page 73 for information on how to configure the Calibration Mode.
Wait Time [s]	<p>The length of time in seconds that the Taurus waits after the calibration coil has been enabled before it sends the calibration signal.</p> <p>The default setting is 0.</p>
Ramp Duration [s]	<p>The length of time in seconds the Taurus uses to bring the signal amplitude up to the configured amplitude and down from the configured amplitude.</p> <p>The default setting is 0.</p> <p>Note: The ramp duration is usually set to 0 for pulse and PRB signals.</p>
Duration [s]	<p>The length of time in seconds during which the Taurus applies the calibration signal to the sensor at the configured amplitude.</p> <p>The default setting is 60.</p>
Sine Frequency [Hz]	<p>The sine signal frequency in hertz</p> <p>Enter a number between 0.01000 and 50.0000.</p> <p>The default setting is 1.0.</p> <p>Note: This setting is ignored for pulse and PRB signals.</p>
Pulse Duration [ms]	<p>The pulse signal segment width in milliseconds.</p> <p>The default setting is 1000.</p> <p>Note: This setting is ignored for sine and PRB signals.</p>
PRB Pulse Width	<p>The PRB (Pseudo-Random Binary) signal unit pulse width in milliseconds</p> <p>The default setting is 1000.</p> <p>Note: This setting is ignored for pulse and sine signals.</p>
Enable Channel 1	Select this option if you want channel 1 enabled for calibration.
Enable Channel 2	Select this option if you want channel 2 enabled for calibration.
Enable Channel 3	Select this option if you want channel 3 enabled for calibration.

4. Select **Apply**.
5. Select **Commit**.

8.4.1 Performing a Calibration

To calibrate a sensor

1. Click  and select **Sensor** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Sensor** page. (display screen)

2. Select the Start calibration button .

The time it takes a calibration to run depends on the calibration settings. The total run time consists of the wait time + ramp duration + duration. For example, if wait time is set as 120 seconds, ramp duration is set as 120 seconds, and duration is set as 120 seconds, then the total calibration run time is 360 seconds. For more information, see [Section 8.4 "Configuring Sensor Calibration"](#) on page 76.

3. If required, you can stop the calibration before it has finished running by selecting the Stop calibration button .

Part 3

Recording, Retrieving, and Streaming Data

- ◆ Recording Data
- ◆ Viewing and Retrieving Data
- ◆ Streaming Data

Chapter 9

Recording Data

9.1 Data Stores

Data is put into Nanometrics Protocol packets (NP packets). The Taurus buffers the NP packets for all data types and writes them to a Store on the removable media (a CompactFlash card or an IDE hard drive). A data Store contains time series, state of health (SOH), and log data. The data is organized into bands, which are groups of data that might contain one or more channels. Bands in the Store contain data packets in multiple data blocks with a default size of 1 MB.

A Store works as a ring buffer. It will wrap around when it is full and record over the oldest data that can be overwritten while preserving all data types. The Taurus will select the oldest data block to overwrite as long as that is not the only data block for that band. If it is the only data block for that band, it will search for the next available data block to overwrite.

A single Store can encompass many files, each being up to 1 GB in size. This is transparent when using the Store on the Taurus, but is relevant if you are planning to copy a Store to your computer because you must copy all files for that Store if you want to extract data later on.



You might notice that some of the files are very small. This is because the Store files allocate disk space as required.

A single recording medium can contain multiple Stores although this is not recommended. For more information, see [Section 9.1.1.1 "About Appended Stores"](#) on page 82.

9.1.1 Creating Stores

The Taurus will either create a Store automatically or prompt you to create one.

- ◆ The Taurus creates a Store automatically after formatting a new medium in the active media slot (see [Section 9.2.2.1 "Formatting Unformatted Media"](#) on page 87).
- ◆ The Taurus prompts you to create a new Store
 - After it deletes the currently active Store (see [Section 9.1.2 "Deleting and Recreating Stores"](#) on page 83)
 - When it switches to the medium in the other media slot after formatting that medium (see [Section 9.2.3 "Switching Recording to the Other Medium"](#) on page 88)

If you insert a used medium that is already formatted to the Linux file system ext3 but does not contain a Store, the Taurus will need at least 200 MB of free space on the medium to create a Store. If the Taurus creates a Store automatically, it will use the last Store capacity setting from the Taurus configuration when it creates the new Store. It will set the Store capacity to 90% of the maximum space on the medium if the last Store configuration was set to Full. If the last Store configuration was for a specific capacity (for example, 800MB), the Taurus will create a Store of that capacity if there is sufficient space on the medium.

If the last configured Store size was 1 GB (1000 MB) on CF and the current medium is a 1 GB CF, there still will not be sufficient space after deleting all files or formatting the medium because the Taurus will require some of the space for other operations.

If there is insufficient space on the medium (less than 200 MB), the Status page displays a Status Error and the Status Detail page shows the error Not Enough Space or No Store. The Store Tools page provides more details about why the error occurred. If there is insufficient space on the medium, you have the following options:

- ◆ Switch to the other medium if it is available.
You can then log in, switch media, and create a Store with a capacity from the list of available options.
- ◆ Delete files from the small medium to free up sufficient space.
- ◆ Format the small medium.



Formatting will destroy all data and partition information on the medium.

9.1.1.1 About Appended Stores

If you insert a medium that contains a Store previously created on the same Taurus (the Store ID contains the Taurus serial number where the Store was originally created), the Taurus will append data to the existing Store. If there is more than one Store on the medium, the Taurus will append to the Store identified by its own serial number if it exists. Otherwise, the Taurus will append data to a randomly chose Store.



It is recommended that you do not use existing Stores created on other Tauruses. You can insert media with existing Stores and then either delete the existing Stores or format the medium and create a new Store to record data from the current Taurus (see [Section 9.1.2 "Deleting and Recreating Stores"](#) on page 83 or [Section 9.2.2.2 "Formatting Previously Formatted Media"](#) on page 87).

If you do use a combined Store, note the following:

- ◆ A Store incorporates the serial number of the Taurus on which it was created as a means of identifying that Store. The file names will use the original Taurus serial number.
- ◆ The original data channels in that Store remain intact until the Store wraps. When the Store wraps, the oldest data is always removed first regardless of which Taurus created that data.
- ◆ The Month page will never display 100% data availability if you select **All Instruments** from the list in the upper-right corner of the Data Availability page.

9.1.2 Deleting and Recreating Stores

You can delete the active Store (the Store that is currently in use) and recreate it.



When you delete a Store, all data in the Store is permanently deleted.

1. Log in and select **Store Tools** from the main menu.
You have to be logged in to delete a Store. For more information, see [Section 2.3.1 "Logging In"](#) on page 24.
2. Select **Delete Store**.
3. Select the Store capacity of the new Store that will be created from the Store Size list.
The list of options is based on the available space on the medium. The option Full will use all available space on the medium.
4. Select **Destroy & Recreate Store** to delete the current Store and create a new one with the capacity you selected in [step 3](#).

9.1.3 Reindexing Stores

If the Taurus is not shut down properly (using the Shutdown page) before the power is disconnected, the Store might need to be reindexed. If this is the case, the Taurus will automatically reindex the Store on start-up.

If you think that some of the recorded data in the Store is missing from the Data Availability lists, you can manually reindex the Store. When you reindex the Store, the index within the Store is recalculated and synchronized with the actual data that is available.

Reindexing might take a long time depending on how much data is in the Store. Data will continue to be generated during reindexing and will not be lost. You will not be able to perform any other operations that involve the Store at the same time.

1. Log in and select **Store Tools** from the main menu.
You have to be logged in to reindex a Store. For more information, see [Section 2.3.1 "Logging In"](#) on page 24.



You can click the help button  to view information about the options on the Store Tools page.

2. Select **Reindex Store**.
3. Select **Yes** to confirm that you want to reindex the Store.

9.2 Recording Media

Taurus removable recording media options include a 1.8" ATA hard disk drive (IDE hard drive) and a CompactFlash card (CF) (see [Section A.6 "Internal Data Storage"](#) on page 111 for specifications). These are accessible via the media door (see on page 85).



Hard drives can be damaged permanently if they are operated at altitudes or temperatures beyond specified high and low limits. Do not operate the Taurus if it is at an altitude or unit temperature outside the specified ranges for the installed media type. SanDisk Extreme CompactFlash cards can be used across the full operating environmental range of the Taurus. See [Section A.14 "Environmental"](#) on page 114 for the operating range specifications.

9.2.1 Replacing Recording Media

The Taurus continues to collect and buffer data while the Controller is shut down. The Controller starts up again when you close the media door. If you want to preserve all of the buffered data, replace the media and close the media door before the data buffer fills. The time elapsed before the buffer fills will range from a few minutes to several hours, depending on factors including the number of active channels, sample rate, seismic signal and noise, and buffer size.



The buffer size for Tauruses with serial numbers 353, 375, and 379 and higher is 2 MB. The buffer size for all other Tauruses is 1 MB.

The buffer size for a Trident 305 is 2MB.

For example, for 3 channels at 100sps and 2MB RAM, typically you would have approximately 30 minutes to remove the current medium, insert the new medium, and close the media door before the buffer wraps and begins to overwrite the oldest data in the buffer.



You can damage the Store or the recording media if you insert or remove the media while the Controller is running. Do not remove or insert media if the Media Status LED is red or orange. Wait until the Controller has shut down and the Media Status LED is green (see on page 85). For more information, see [Section 3.2 "Status LEDs"](#) on page 32.

1. Click  and select **Shutdown** from the main menu. (Web browser)

-OR-

Press the top key to open the main menu, press the bottom key to select **Shutdown**, and press the centre key. (display screen)

2. Select **Shutdown**.

The status LEDs indicate when shut down has completed:

- The SuperLED has switched to a slow blinking pattern.
- The Media Status LED is green.
- The Ethernet Status LED is off.

- Lift the black plastic lever on the media door knob and twist the door knob counter-clockwise to the unlocked position (vertical) (Figure 9-1) and remove the door.

Air pressure differential inside versus outside the Taurus case (for example, if the Taurus was transported by air) might make the media door difficult to remove. If this occurs, loosen (but do not remove) the pressure relief screw (Figure 1-4 on page 11) to allow the pressure to equalize. Remove the media door and then gently tighten the pressure relief screw (hand-tight is sufficient).

Figure 9-1 Opening the media door



- Check that the Media Status LED status is green (). Do not remove the IDE/CF if the Media Status LED is red or yellow (solid or blinking). For more information, see Section 3.2.3 “Media Status LED” on page 34.

Figure 9-2 Replacing the recording media



- Gently pull on the end of the IDE/CF to remove it.
- Gently insert the replacement IDE/CF.



The media door can only be closed only if it is positioned correctly. Ensure the door is inserted right-side up before you try to close it.

- Push the media door in place and twist the door knob clockwise to the locked position (horizontal).
- Rotate the black plastic lever down so that it lies flat against the door.

Closing the media door will start the Controller. If you want to start the display screen, press the centre key for about 1 second. The display screen will start up once the Controller has finished booting.

The Store options for the replacement medium are as follows:

- ◆ If the active medium contains a Store, the Taurus will append data to that Store automatically. If the Store was created on a different Taurus, it is recommended that you delete the existing Store and create a new one ([Section 9.1.2 “Deleting and Recreating Stores”](#) on page 83).
- ◆ If the medium is not formatted to ext3, you can format it and create a new Store ([Section 9.2.2 “Formatting Recording Media”](#) on page 86).
- ◆ If the active medium is formatted to ext3 but does not yet contain a Store, the Taurus will create one automatically using the last Store configuration settings (see [Section 9.1.1 “Creating Stores”](#) on page 81).

9.2.2 Formatting Recording Media

Formatting is not necessary for media shipped from Nanometrics because they are preformatted to the Linux file system ext3.

You can use the Taurus to format media from a different file system format to ext3 and to reformat used media that is already formatted to ext3. The procedure you use depends on whether one or both media types are inserted in the Taurus, which medium is the active one, and whether the media is already formatted to ext3 (see [Table 9-1 “Media formatting options”](#) on page 86). The active medium is the one the Taurus is currently configured to use for recording data.

Formatting will destroy all existing data and partition information on the medium. The Taurus will create two directories on the medium immediately after completing the formatting: /mnt/mediaType/logs and /mnt/mediaType/Store.

Table 9-1 Media formatting options

Media installed	Formatting option
One formatted, active medium	You cannot format the active medium if it is already formatted. Note: If you want to reuse the medium, you can delete the Store on it and recreate it. For more information, see Section 9.1.2 “Deleting and Recreating Stores” on page 83.
One formatted, inactive medium	You can format the inactive medium whether or not it is already formatted.
Two formatted media (one active, one inactive)	You cannot format the active medium if it is already formatted but you can format the inactive medium. To format the currently active medium, switch the media to the other medium first. For information on how to do this, see Section 9.2.3 “Switching Recording to the Other Medium” on page 88.
Unformatted media	You can use the format media options on the Store Tools page to format unformatted, inserted media.

9.2.2.1 Formatting Unformatted Media

When the Taurus detects unformatted media, it will indicate on the Store Tools page that the media does not exist or is not formatted and will provide the options to format, switch, reindex, and delete the media depending on the media status.

1. Shut down the Taurus and follow the steps in [Section 9.2.1 “Replacing Recording Media”](#) on page 84 to replace the recording media.
2. Log in and select **Store Tools** from the main menu.

You have to be logged in to format unformatted media. For more information, see [Section 2.3.1 “Logging In”](#) on page 24.



You can click the help button  to view information about the options on the Store Tools page.

3. Select **Format MediaType** for the medium you want to format.
 - If this is the currently active media type, the Taurus will format the medium and create a Store using the last Store configuration settings (see [Section 9.1.1 “Creating Stores”](#) on page 81). The Taurus will start recording to it automatically.
 - If this is the currently inactive media type, the Taurus leaves it as the inactive medium after formatting it. If you want to record to the currently inactive medium, you can switch the media after formatting is complete (see [Section 9.2.3 “Switching Recording to the Other Medium”](#) on page 88).
4. Select **Yes** on the confirmation page.

9.2.2.2 Formatting Previously Formatted Media

When the Taurus detects formatted media in the active slot, it will show the Store size and Store space used. When it detects formatted media in the inactive slot, it will indicate that the media is available. Options to format, switch, reindex, and delete the media are available depending on the media status.

If a medium is already formatted to ext3, you can only reformat it if it is inactive. If you want to reformat the active medium, you can install both media types, switch to the other medium, and then reformat. For information on how to do this, see [Section 9.2.3 “Switching Recording to the Other Medium”](#) on page 88.

If you want to reuse a medium with an old Store and do not need to reformat it, you can delete the Store and recreate it (see [Section 9.1.2 “Deleting and Recreating Stores”](#) on page 83).

1. Log in and select **Store Tools** from the main menu.

You have to be logged in to format unformatted media. For more information, see [Section 2.3.1 “Logging In”](#) on page 24.

2. Select **Format MediaType**.
3. Select **Yes** on the confirmation page.



If you select the option to switch media after formatting is completed (see [Section 9.2.3 “Switching Recording to the Other Medium”](#) on page 88), you will be prompted to select the new Store capacity from the list of available options.

9.2.3 Switching Recording to the Other Medium

If you have media installed in both slots, you have the option to switch to the inactive medium if it is already formatted.

To switch to the other medium

1. Log in and select **Store Tools** from the main menu.
2. Select **Switch Media**.
3. If there is no Store on the formatted inactive medium, you will be prompted to create one and select a capacity for the new Store from the Store Size list.

-OR-

If a Store already exists on the inactive medium, you will be prompted to confirm that you want to use that Store.

The Taurus will append data to that Store (see [Section 9.1.1.1 "About Appended Stores"](#) on page 82).

4. Select **Yes** on the confirmation page

Chapter 10

Viewing and Retrieving Data

10.1 Viewing Data in Near Real Time

The Status, Waveform, SOH, Timing, and Sensor pages all show near real-time data. The lag is the page refresh rate (every 5 seconds).

See the following sections in [Appendix G "UI Pages"](#) for an overview of the data shown on each page:

- [Section G.1 "Status"](#) on page 138
- [Section G.2 "Waveform"](#) on page 141
- [Section G.3 "SOH"](#) on page 142
- [Section G.5 "Timing"](#) on page 145
- [Section G.6 "Store Tools"](#) on page 147



You can select waveform scaling options on the Waveform and Sensor pages (see [Table G-3 "Waveform page overview"](#) on page 141 for a description).

10.2 Retrieving and Accessing Data

The Taurus records all time series data, SOH data, system logs, and system configuration information to the Store. You can extract data from the Store using the following data retrieval options:

- ◆ Retrieving data from the Store over an IP connection and saving it on your network:
 - [Retrieving Time Series Data](#)
Time series data can be extracted in the following formats: MiniSEED, MiniSEED Sorted, ASCII, SEG Y, or Seisan.
 - [Extracting State of Health Data](#)
 - [Extracting System Logs](#)
 - [Extracting the Configuration Audit Trail](#)
 - [Downloading Taurus System Information](#)
- ◆ [Accessing Store Files on the Recording Media](#)

One data retrieval request can be run at a time. Any subsequent retrieval requests will be processed when the current download is finished. You can run a data retrieval request at the same time as data is streaming to an acquisition server.



Before you download data, you can view what data is available for download on the Data Availability pages. You can also view a summary of the available data and details about data gaps and time tears. See [Section G.4 "Data Availability"](#) on page 143 for a description of the Data Availability page options.

10.3 Retrieving Time Series Data

You can retrieve time series data from the Store (either from the Taurus directly or from removed media) by extracting it to a file in the following formats: MiniSEED, MiniSEED Sorted, ASCII, SEG Y, or Seisan. You have two options for extracting seismic data:

- [Section 10.3.1 "Extracting Seismic Data"](#) on page 90
- [Section 10.3.2 "Extracting Seismic Data by Event"](#) on page 92

You can also stream time series data from the Taurus to a central acquisition server, for example to write the data to NAQSServer ringbuffers. For more information, see [Section 11.1 "Streaming Data in NP Format"](#) on page 101.



Trigger information is available as an SOH download ([Section 10.4 "Extracting State of Health Data"](#) on page 95).

10.3.1 Extracting Seismic Data

You can extract time series data from the Store to a file in the following formats: MiniSEED, MiniSEED Sorted, ASCII, SEG Y, or Seisan. Before you extract data to the MiniSeed Sorted, SEG Y, or Seisan format for the first time, you have to install a conversion program on your computer. You are instructed to do this just before you start the download of the data.

To download time series data

1. Click  and select **Data Retrieval** from the main menu on a Web browser.
2. Click **Time series** and click **Next**.
3. Select one or more channels and click **Next**.
4. Select the start time (Month, Day, and Time) and end time (Duration) of the data you want to extract and click **Next**.

-OR-

Click **Show Available Times** and select a time.

5. Click the format you want to extract seismic data in and click **Next**.

Format	Description
MiniSEED	The MiniSEED format is a subformat of the SEED data format. MiniSEED data only contains waveform data; no station or channel metadata is included. Note: The extracted file uses a 512 byte Data Record Length. More than 488MB of data cannot be downloaded in MiniSEED format. Use multiple downloads for quantities of data that exceed 488MB.
MiniSEED Sorted	The MiniSEED Sorted format is identical to the MiniSEED format in terms of content but the data is divided into blocks (you specify the size) and put into chronological order from oldest to newest.
ASCII	The ASCII format is a plain text file that can be viewed with any text editor.
SEG Y	The SEG Y file format is a standard format developed by the Society of Exploration Geophysicists for storing geophysical data.
Seisan	The Seisan file format is a waveform file that can be used with the SEISAN earthquake analysis software. The extracted files have been tested with Seisan version 8.1. Note: The extracted file uses a 512 byte Data Record Length. More than 488MB of data cannot be downloaded in Seisan format. Use multiple downloads for quantities of data that exceed 488MB.

6. If you selected MiniSEED or ASCII as the data format, go to [step 11](#).
-OR-
If you selected MiniSEED Sorted as the data format, go to [step 7](#).
-OR-
If you selected SEG Y as the data format, go to [step 9](#).
-OR-
If you selected Seisan as the data format, go to [step 10](#).
7. Enter the full file name of the file you want to extract the data to in the File destination box.
For example:
C:\TaurusData\Output.seed
/home/nmx/taurusdata/output.seed
8. Select the block size for each block of data, click **Next**, and go to [step 10](#).
9. Enter the full file name of the file you want to extract the data to in the File destination box and click **Next**.
For example:
C:\TaurusData\Output.sgy or C:\TaurusData\Output.segy
/home/nmx/taurusdata/output.sgy or /home/nmx/taurusdata/output.segy
10. Click the **Download it** link, follow the instructions in the compressed folder to install the conversion program for the format you selected (MiniSEED Sorted, SEG Y, or Seisan), and then go to [step 11](#).

11. Review the settings and click **Download**.

- ▶ To change the settings; click one of the links to return to the appropriate settings page, change the settings, and then click **Next** to return to the Download page.
- ▶ Click **Clear All Choices** to delete all of the current settings and return to the Data Retrieval main page.

12. If you selected MiniSEED or ASCII as the data format, save the file.

You can view the MiniSEED file in any MiniSEED reader and you can view the ASCII file in any text editor.

-OR-

If you selected MiniSEED Sorted, SEG Y, or Seisan as the data format, open the file with the conversion program you installed for that format.

10.3.2 Extracting Seismic Data by Event

You can retrieve seismic data from a Taurus using information from an event list. The event list can be a file that you upload to the Taurus (for example, a list of events from third-party Internet sites) or information for a single event that you enter into a form.

The Taurus calculates arrival times for various phases that are applicable to the event selected. The supported phases include the following: P, S, Pn, Sn, PKiKP, SKiKS, PcP, ScS, PKP, SKS, Pdif, and Sdif. Travel time tables are used to calculate the estimated time it takes a seismic wave to travel distance from a seismic event to a specified location. This is used to determine what data to download for a known teleseismic event. The travel time tables used in Taurus are calculated using the Tau algorithm, using the TauP Java Package (<http://www.seis.sc.edu>). TauP outputs files for any velocity model the user wants. The Taurus uses the IASPEI91 default model, which is commonly used for teleseismic events.

To download time series data by event

1. Click  and select **Data Retrieval** from the main menu on a Web browser.
2. Click **Time series by event** and click **Next**.
3. Select one or more channels and click **Next**.
4. Click the type of event list file you want to upload and go to [step 5](#).

-OR-

Go to [step 9](#) to manually enter an event.

5. Download the event list file from the linked site and save it to your local computer.

Event List	Steps
IRIS Search - ASCII http://www.iris.edu/quakes/eventsrch.htm	<ol style="list-style-type: none"> 1. Submit a search for the time period you are interested in. 2. Click the ASCII version link at the top of the search results page. 3. Save the ASCII version to your local computer. <p>Note: An IRIS event list cannot be used with the Network name NE. If the Network name displayed in the Station Info section is NE, select the Choose Station Info link to change it. For more information, see Section 10.8 "Configuring Data Retrieval Settings" on page 99.</p>
NEIC Epic Search - Compressed http://neic.usgs.gov/neis/epic	<ol style="list-style-type: none"> 1. Select a search area. 2. Click Compressed File Format as the output file type. 3. Select the search parameters and click Submit Search. 4. Save the .html search results file to your local computer.
NEIC Finger http://neic.usgs.gov/neis/finger/quake.asc	<ul style="list-style-type: none"> ▶ Save the file quake.asc to your local computer.

6. Click **Browse**, select the saved file, and click **Upload**.
7. Click **Next**.
8. Click an event from the list, click **Next**, and go to [step 13](#).
9. Enter a name for the event in the Label box.
You can enter an ASCII string of any length.
10. Enter the event time as an ASCII string with the following format: yyyy-MM-dd HH:mm:ss
11. Enter the location of the event as a comma-separated list of the latitude, longitude, and depth.
12. Click the event once you have filled in the information and then click **Next**.
13. Select the pre-event and post even times and start and end phases.

Option	Description
Pre-Event Time	Number of seconds of data downloaded before calculated start time
Start Phase	Phase when data starts downloading
Post Event Time	Number of seconds of data downloaded after the calculated end time
End Phase	Phase when data stops downloading

14. Click **Next** to search the Taurus data for the event.

If there is no data for the selected event, you can search for another event in the currently uploaded list or enter another event by clicking the **Change Event** link.

15. Click the format you want to extract seismic data in and click **Next**.

Format	Description
MiniSEED	The MiniSEED format is a subformat of the SEED data format. MiniSEED data only contains waveform data: no station or channel metadata is included. Note: The extracted file uses a 512 byte Data Record Length. More than 488MB of data cannot be downloaded in MiniSEED format. Use multiple downloads for quantities of data that exceed 488MB.
MiniSEED Sorted	The MiniSEED Sorted format is identical to the MiniSEED format in terms of content but the data is divided into blocks (you specify the size) and put into chronological order from oldest to newest.
ASCII	The ASCII format is a plain text file that can be viewed with any text editor.
SEG Y	The SEG Y file format is a standard format developed by the Society of Exploration Geophysicists for storing geophysical data.
Seisan	The Seisan file format is a waveform file that can be used with the SEISAN earthquake analysis software. The extracted files have been tested with Seisan version 8.1. Note: The extracted file uses a 512 byte Data Record Length. More than 488MB of data cannot be downloaded in Seisan format. Use multiple downloads for quantities of data that exceed 488MB.

16. If you selected MiniSEED or ASCII as the data format, go to [step 21](#).

-OR-

If you selected MiniSEED Sorted as the data format, go to [step 17](#).

-OR-

If you selected SEG Y as the data format, go to [step 19](#).

-OR-

If you selected Seisan as the data format, go to [step 20](#).

17. Enter the full file name of the file you want to extract the data to in the File destination box.

For example:

C:\TaurusData\Output.seed

/home/nmx/taurusdata/output.seed

18. Select block size for each block of data, click **Next**, and go to [step 20](#).

19. Enter the full file name of the file you want to extract the data to in the File destination box and click **Next**.

For example:

C:\TaurusData\Output.sgy or C:\TaurusData\Output.segy

/home/nmx/taurusdata/output.sgy or /home/nmx/taurusdata/output.segy

20. Click the **Download it** link, follow the instructions in the compressed folder to install the conversion program for the format you selected (MiniSEED Sorted, SEG Y, or Seisan), and then go to [step 21](#).

21. Review the settings and click **Download**.

- ▶ To change the settings; click one of the links to return to the appropriate settings page, change the settings, and then click **Next** to return to the Download page.
- ▶ Click **Clear All Choices** to delete all of the current settings and return to the Data Retrieval main page.

22. If you selected MiniSEED or ASCII as the data format, save the file.

You can view the MiniSEED file in any MiniSEED reader and you can view the ASCII file in any text editor.

-OR-

If you selected MiniSEED Sorted, SEG Y, or Seisan as the data format, open the file with the conversion program you installed for that format.

10.4 Extracting State of Health Data

You can extract various types of SOH data from the Store to a comma-separated values file (.csv) on your local computer.

Predefined sets of SOH data are provided in the list on the SOH Data page. If you want to download an individual SOH data column, such as Media Bay Door State, follow the steps for extracting Trigger data ([Section 10.5 "Extracting System Logs"](#) on page 98).

To download the SOH file

1. Click  and select **Data Retrieval** from the main menu on a Web browser.
2. Click **State of health** and click **Next**.

3. Select the SOH data group that you want to extract from the list and go to [step 6](#).

Predefined SOH group	SOH data
GPS Time	<ul style="list-style-type: none"> ♦ Time in longsecs format (the number of seconds since 1970-01-01) ♦ UTC time in yyyy-mm-dd hh:mm:ss.ms format ♦ Latitude (°) ♦ Longitude (°) ♦ Elevation (m) ♦ GPS receiver status ♦ Number of satellites used ♦ PDOP ♦ TDOP ♦ System clock phase lock ♦ Time uncertainty (ns) ♦ DAC count ♦ Time error (ns) ♦ Last update time (s) <p>Note: The values for Number of satellites used, PDOP, and TDOP are provided by the GPS receiver at the Last update time. In order to see what time these values correspond to, look at the Last update time. When GPS is off, these three parameters and the Last update time are not updated. The last value displays until the next update arrives (after the GPS is turned on again).</p>
GPS Satellites	<ul style="list-style-type: none"> ♦ Time in longsecs format (the number of seconds since 1970-01-01) ♦ UTC time in yyyy-mm-dd hh:mm:ss.ms format <p>For each satellite</p> <ul style="list-style-type: none"> ♦ Acquisition type ♦ Azimuth (μ°) ♦ Elevation (μ°) ♦ PRN code ♦ Signal level (AMU) ♦ Last update time (ms)
Environment SOH	<ul style="list-style-type: none"> ♦ Time in longsecs format (the number of seconds since 1970-01-01) ♦ UTC time in yyyy-mm-dd hh:mm:ss.ms format ♦ External SOH Voltage 1 (12-bit, voltage input) (V) ♦ External SOH Voltage 2 (12-bit, voltage input) (V) ♦ External SOH Voltage 3 (12-bit, voltage input) (V) ♦ External SOH Voltage 4 (12-bit, voltage input) (V) ♦ Sensor SOH Voltage 1 (V) ♦ Sensor SOH Voltage 2 (V) ♦ Sensor SOH Voltage 3 (V)

Predefined SOH group	SOH data
Instrument	<ul style="list-style-type: none"> ♦ Time in longsecs format (the number of seconds since 1970-01-01) ♦ UTC time in yyyy-mm-dd hh:mm:ss:ms format ♦ Supply voltage (mV) ♦ Temperature (°C) ♦ NMXbus current (external connector) (mA) ♦ Sensor current (mA) ♦ Serial port current (mA) ♦ Controller current (mA) ♦ Digitizer current (mA)
PowerPC	<ul style="list-style-type: none"> ♦ Time in longsecs format (the number of seconds since 1970-01-01) ♦ UTC time in yyyy-mm-dd hh:mm:ss:ms format ♦ Ethernet ♦ Packets

-OR-

If you want to extract specific types of SOH data, go to [step 4](#).

4. Select **User Selected** from the list, select a specific type of SOH data from the Available Columns list, and click **Add** to add it to the Selected Columns list.

For example, if you only want to extract Trigger SOH data, then add Trigger to the Selected Columns list and go to [step 6](#).

5. Repeat [step 4](#) until you have added all of the specific SOH data you want to extract.
6. Click **Next**.
7. Select the start time (Month, Day, and Time) and end time (Duration) of the data you want to extract and click **Next**.

-OR-

Click **Show Available Times** and select a time.

8. Review the settings and click **Download**.
 - ▶ To change the settings; click one of the links to return to the appropriate settings page, change the settings, and then click **Next** to return to the Download page.
 - ▶ Click **Clear All Choices** to delete all of the current settings and return to the Data Retrieval main page.
9. Click **OK** to save the file to your desktop.

You can open the .log file with any text editor.

10.5 Extracting System Logs

You can extract the Taurus system logs from the Store to a text file (.log) and save it on your local computer.

To download the system log file

1. Click  and select **Data Retrieval** from the main menu on a Web browser.
2. Click **System Logs** and click **Next**.
3. Select the start time (Month, Day, and Time) and end time (Duration) of the data you want to extract and click **Next**.

-OR-

Click **Show Available Times** and select a time.

4. Review the settings and click **Download**.
 - ▶ To change the settings; click one of the links to return to the appropriate settings page, change the settings, and then click **Next** to return to the Download page.
 - ▶ Click **Clear All Choices** to delete all of the current settings and return to the Data Retrieval main page.
5. Click **OK** to save the file to your desktop.

You can open the .log file with any text editor.

10.6 Extracting the Configuration Audit Trail

The Taurus maintains an audit trail of all configuration changes since the Store was created. You can extract this audit trail from the Store as a file and save it on your local computer. The format of the Taurus configuration audit trail file is Terse RDF Triple Language (Turtle), which is a syntax for the Resource Description Framework (RDF). For information on Turtle, see <http://www.ilrt.bris.ac.uk/discovery/2004/01/turtle>. For information on RDF, see <http://www.w3.org/RDF>.

You can view the configuration audit trail file to determine the exact state of the configuration for the Taurus at any point since the Store was created. The configuration audit trail file contains configuration data, metadata, and a list of audit trail events. When any of the following occur, they are recorded as events in the audit trail:

- The Store is opened (which includes when the Taurus starts up).
- A configuration change is applied.
- A configuration change is committed.

To download the configuration audit trail file

1. Click  and select **Data Retrieval** from the main menu on a Web browser.
2. Click **System configuration** and click **Next**.
3. Select the start time (Month, Day, and Time) and end time (Duration) of the data you want to extract and click **Next**.

-OR-

Click the **Show Available Times link** and select a time.

4. Review the settings and click **Download**.

To change the settings; click one of the links to return to the appropriate settings page, change the settings, and then click **Next** to return to the Download page.

Click **Clear All Choices** to delete all of the current settings and return to the Data Retrieval main page.

5. Click **OK** to save the file to your desktop.

You can open the .ttl file with any text editor.

10.7 Downloading Taurus System Information

You can download the firmware and hardware information for the Taurus as a Terse RDF Triple Language (Turtle) file and save it on your local computer.

To download the system information file

1. Click  and select **System info** from the main menu on a Web browser.
2. Click the **Download** link on the Firmware tab.
3. Click **OK** to save the file to your desktop.

You can open the .ttl file with any text editor.

10.8 Configuring Data Retrieval Settings

Data retrieval information is used in extracted time series data file headings and in the default file names for all types of extracted data. The data retrieval settings are used as labels to help you identify the retrieved data.

You can change the data retrieval settings temporarily for the current data extraction or you can change the settings for all downloads.

To change the data retrieval settings for the current data extraction

1. Click  and select **Data Retrieval** from the main menu.
2. Select the type of data you want to retrieve and select **Next**.
3. Select the **Change Station Info** link.
4. Edit the station information as required and select **Next**.
5. Select the start time (Month, Day, and Time) and end time (Duration) of the data you want to extract and click **Next**.

-OR-

Click **Show Available Times** and select a time.

6. Select **Download**.

To change the data retrieval settings for all data extractions

1. Log in and select **Configuration > Data Retrieval** from the main menu.

You have to be logged in to change data extraction settings. For more information, see [Section 2.3.1 “Logging In”](#) on page 24.

2. Change the settings as required.

For more information, see [Section H.6 “Data Retrieval”](#) on page 156.

3. Select **Apply**.
4. Select **Commit**.

10.9 Accessing Store Files on the Recording Media

The Taurus media are formatted to use the Linux ext3 file system. You can copy the files to your computer from the Taurus via a means such as FTP. You can access and copy the files on removed media with a media reader such as a Nanometrics Hard Drive Reader or a third-party CompactFlash reader.

All of the Store files must be present in the same directory if you want to view or extract data. (For example, on the Taurus media in a media reader connected to your computer, or copied to a directory on your computer).

- ♦ You can transfer the files from the Taurus to your computer via a means such as FTP.
 - ▶ Ensure FTP is set to binary transfer.
- ♦ If you are using a media reader on Linux, note that some Linux versions will not detect a removable hard drive or CompactFlash card if the computer was not booted with the device attached. After booting with the removable hard drive or CF attached, the device can be removed and exchanged for other media which will be detected.
- ♦ If you are using a media reader on Windows there are various third-party utilities available for you to access the files directly; for example, Ext2IFS and Explore2fs.
 - Ext2 Installable File System For Windows (Ext2IFS) provides a file system driver to include ext3 volumes as fully accessible drives on Windows file systems, and a control panel item for assigning drive letters to ext3 volumes (<http://www.fs-driver.org/index.html>).



As of Explore2fs version 1.07 do not drag and drop a 1 GB file from the medium as this will allocate 1 GB of shared memory on the computer. Use the File > Save As menu option instead. The Save As option supports saving of multiple files.

- Explore2fs provides an Explorer-type graphical user interface for reading files and for copying files from an ext3 file system (see <http://uranus.it.swin.edu.au/~jn/linux/explore2fs-old.htm> for general information, and <http://www.chrysocome.net/explore2fs> for software updates).

Chapter 11

Streaming Data

11.1 Streaming Data in NP Format

You can use NP streamers to stream time-series data and SOH data in NP format from a Taurus to one or more data acquisition servers. You can create and configure an unlimited number of NP streamers.



If you have not created and configured any new NP streamers, then only one NP streamer (the default one) will appear on the NP Streaming page.

When you create a new NP streamer, it will appear on the NP Streaming page and you can select the name to configure it.

You can also delete NP streamers on the NP Streaming page by selecting the Delete button  beside the streamer name.

To stream data in the NP format

1. Ensure that the Taurus is running in Communications mode and that the required communications options are set.

For more information, see [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27.

2. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

3. Select **Data Streaming**.
4. Select **NP Streaming**.
5. Select the **NP Streamer** link.

6. Select the New Item button  to create a new NP streamer.

-OR

Select the name of an existing NP streamer.



You can also select the copy button  to create a copy of an existing NP streamer.

7. Edit the following settings as required:

Setting	Description
Name	The name of the NP streamer This name appears on the NP Streaming page and you can select the name to edit the settings of the streamer.
Enable Streaming	Select this option to enable the NP streamer to stream data. By default, this check box is not selected.
Stream Time Series	Select this option to stream time series data.
Stream NAQS SOH	Select this option to stream SOH data to a NAQSServer. Notes: This option uses less bandwidth than the Stream All SOH option because only the data that NpToNmxp can convert to NAQSServer is streamed. To stream data in a NP format to a NAQSServer, the NpToNmxp utility must be running on the NAQSServer computer. For more information, see the NpToNmxp User Guide.
Stream All SOH	Select this option to stream all SOH data.
IP Address	The valid IP address of the streaming destination in dotted decimal format -OR- A valid multicast IP address The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255. Note: The Naqs.ini file must be configured to listen for this multicast address. For more information, see the NAQSServer User Guide.
Port #	The port number used by Taurus to stream data in the NP format. The default port is 32004.
Multicast TTL	If the streaming destination address is multicast, you can increase the Time-To-Live (TTL) of the packets by specifying the number of networks (routers) that the packet must cross to reach the destination. For example, if the packets have to cross five networks to reach the destination, you should set the Multicast TTL to 5. Caution: All of the routers must support the Time-To-Live feature. In some cases, this feature might be disabled for security reasons (Denial-of-Service attack).

Setting	Description
ReTx Strategy	<ul style="list-style-type: none"> ♦ First-Come, First-Served – ReTx Requests are processed in the order received. Incoming messages that are the same as or part of an existing request are merged and processed in the order of the original request. ♦ Ordered, with Short Term Complete – ReTx Requests are processed in data request time order (oldest first), except for requests with data in the recent past (within the Short Term Complete Threshold). This option is useful if you are using NAQSServer in Short Term Complete mode.
Short Term Complete Threshold [min]	<p>The time in minutes in which recent requests should be processed before oldest requests are processed.</p> <p>The default setting is 5 minutes.</p> <p>Note: You only have to configure this setting if you selected Ordered, with Short Term Complete as the ReTX Strategy.</p>

8. Select **Apply**.
9. If you want to set the maximum data output of the NP streamer because of a low-throughput link, select the **Throttle** link and go to [step 10](#).
-OR-
Go to [step 13](#).
10. Select the **Enable throttle** check box and enter the maximum throughput in bits per second.
11. Select **Apply**.
12. Select **Previous** to return to the configuration page for the NP streamer.
13. If you want to set the maximum packet size for routers that do not allow IP fragmentation, select the **Fragmentation** link and go to [step 14](#).
-OR-
Go to [step 19](#).
14. Select the **Enable Fragmentation** check box and enter the maximum fragment size in bits.
15. If you want a cyclic redundancy check performed on each fragment to verify that the data is not corrupted, select the **Include CRC** check box.
16. Select **Apply**.
17. Select **Commit**.
18. Select **Previous** to return to the configuration page for the NP streamer.
19. Select **Commit** when you have finished configuring the NP streamer.

11.2 Streaming Seismic Data in WIN Format

You can stream seismic data from a Taurus in WIN format.

WIN is a format for multi-channel earthquake waveform data. You can download WIN system code from <http://eoc.eri.u-tokyo.ac.jp/WIN/Eindex.html> and view instructions at http://eoc.eri.u-tokyo.ac.jp/WIN/show_man_index_en.html.

To stream data in the WIN format

1. Ensure that the Taurus is running in Communications mode and that the required communications options are set.

For more information, see [Section 2.4 “Selecting the Taurus Running Mode”](#) on page 27.

2. Click  and select **Configuration** from the main menu. (Web browser)

-OR-

Press the keys to open the main menu and select the **Configuration** page. (display screen)



To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: `tech` or `central`.

3. Select **Data Streaming**.
4. Select **WIN Streaming** and edit the following settings as required:

Setting	Description
Stream WIN Packets	Select this option to stream data in the WIN format. By default, this check box is not selected.
UTC Offset [h]	The amount of time in hours that the time zone used in the WIN packets is offset from Coordinated Universal Time (UTC). The default setting is 9.
IP Address	The valid IP address of the streaming destination in dotted decimal format -OR- A valid multicast IP address The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255.
Port Number	The port number used by Taurus to stream data in the WIN format. The default port is 32005.
Max. Packet Bytes [B]	The maximum number of bytes in each packet The default setting is 1500.

5. Select an **Enable** check box for each of the channels you want to stream data for.
6. Enter a unique decimal or hexadecimal channel number for each enabled channel.
The default channel number for WIN channel 1 is 0x0001.

7. Select **Apply**.
8. If you want to set the maximum data output of the WIN streamer because of a low-throughput link, select the **Throttle** link and go to [step 9](#).
-OR-
Go to [step 13](#).
9. Select the **Enable throttle** check box and enter the maximum throughput in bits per second.
10. Select **Apply**.
11. Select **Commit**.
12. Select **Previous** to return to the configuration page for the WIN streamer.
13. Select **Commit** when you have finished configuring the WIN streamer.

Part 4

Appendices

- ◆ Specifications
- ◆ Connector Pinouts
- ◆ Seismometer-Taurus Interconnection
- ◆ Filter Response
- ◆ Open Source/Free Software Information
- ◆ Firmware Upgrade Procedures
- ◆ UI Pages
- ◆ Configuration UI Pages
- ◆ Glossary

Appendix A

Specifications

A.1 Sensor Input

Channels	3
Sampling	Simultaneous
Hardware gain selection	Software configurable 0.4, 1, 2, 4, 8
Peak-to-peak input voltage range	40V, 16V, 8V, 4V, 2V
Maximum input voltage range	40V _{pp} differential (at hardware gain = 0.4)
Maximum single-ended voltage	±1.56V, 3.12V _{pp} or ±3.6V, 7.2V _{pp} These limits apply to all gain settings.
Maximum common mode signal	±0.78V, 1.56V _{pp} or ±1.8V, 3.6V _{pp} These limits apply to all gain settings.
Nominal sensitivity	1 count/μV (at hardware gain = 1)
Input impedance	Selectable low impedance (43.07kΩ ±0.2%) or high impedance (> 9MΩ)

A.2 Digitizer Performance

Type	Proprietary high order sigma-delta
Digital filter	140 dB attenuation at Nyquist frequency
Filter type	Linear phase (consult factory for other options)
Dynamic range	> 141 dB (maximum sine wave above shorted input level) at 100sps
Shorted input noise	< 1 counts RMS (of 24 bits) at 100sps
Sample rates	10, 20, 40, 50, 80, 100, 120, 200, 250, 500 sps
Software gain	User configurable 0.001 to 100
High pass filter	User configurable 0.001 to 1.0Hz

A.3 Sensor Support

Sensor types	Broadband active and short period passive
Control lines	6 Typically used for Cal enable, mass centre, and mass lock/unlock. The following assert/deassert levels can be configured: <ul style="list-style-type: none"> ♦ Assert (On): High Z, Zero, Positive (5V, 12V) ♦ Deassert (Off): High Z, Zero, Positive (5V, 12V)
Mass position	Mass position monitoring, $\pm 10V$ range
Sensor power	<ul style="list-style-type: none"> ♦ Supply power pass-through to sensor (9V to 36V DC) ♦ Protected against short circuit ♦ Sensor power can be switched on/off from the user interface
Calibration signal	<ul style="list-style-type: none"> ♦ Ramped sine wave (Sine) ♦ Pseudo-random binary (PRB) ♦ Pulse signal (Pulse)
Calibration control	User interface (local or remote)
Calibration mode	Voltage or current

A.4 Timing Subsystem

Timing system	Internal VCXO clock disciplined to GPS
Timing accuracy	<100 μ s
GPS receiver	Internal 8 channel or 12 channel
GPS antenna	External active antenna; 3.3V, 100mW
Duty cycle	Software configurable

A.5 State-Of-Health (SOH)

Continuously recorded SOH	See step 3 of Section 10.4 "Extracting State of Health Data" on page 95. <ul style="list-style-type: none"> ♦ Instrument ♦ Environment ♦ GPS time ♦ GPS satellites ♦ PowerPC
External SOH	4 analog SOH channels (12-bit, digitized), available for user-defined purposes
Configuration	Configuration audit trail
Log file	All software-generated log messages are stored with the data

A.6 Internal Data Storage

Standard	Removable, accessed via the media door <ul style="list-style-type: none"> • CompactFlash – SanDisk Extreme Series: tested up to 4GB capacity with Taurus • 1.8" IDE disk drive – 20GB to 60GB
Duration	> 600 days continuous recording, 3 channels at 100sps on 40GB IDE drive (~30 days on 2GB CompactFlash)
Recording modes	Continuous ring buffer (overwrites oldest data)
File system	Linux ext3
Storage format	Nanometrics Store Streaming data output in NP format; extraction to MiniSEED, ASCII, Seisan

A.7 Data Retrieval

Media exchange	Removable IDE hard drive or CompactFlash card
Download interfaces	10/100Base-T Ethernet, serial (or PPP)

A.8 Real-time Data Communication

Interfaces	<ul style="list-style-type: none"> • 10/100Base-T Ethernet • RS-232 serial. Port 1 has all RS-232 signals; Port 2 has Rx, Tx, RTS, CTS
Protocols	<ul style="list-style-type: none"> • UDP/IP unicast/multicast • HTTP (POST and GET) • RS-232 serial with IP drivers

A.9 Integrated User Interface

LEDs	System status (tri-colour), Ethernet communication status, media write status
Colour display	240x320 colour graphics LCD display with backlight 3.5" diagonal
Input device	5-key navigation control for internal browser

A.10 Software

Operating system	Embedded Linux
Applications software	Nanometrics Apollo Data Acquisition Server with Web interface

A.11 Connectors

Sensor	26-socket, shell size 16, MIL-C-26482 Series 1 Mating connector MS3116J16-26P
GPS	TNC female Mating connector TNC male
Power	3-pin, shell size 8, MIL-C-26482 Series 1 Mating connector MS3116J8-3S
USB/Serial	19-socket, shell size 14, insert position W, MIL-C-26482 Series 1 Mating connector MS3116J14-19PW
Ethernet	4-socket, shell size 8, insert position W, MIL-C-26482 Series 1 Mating connector MS3116J8-4PW
SOH	7-socket, shell size 10, MIL-C-26482 Series 1 Mating connector MS3116J10-7P
NMXbus	4-pin, shell size 8, MIL-C-26482 Series 1 Mating connector MS3116J8-4S
USB	Mini USB Type AB socket Mating connector mini USB Type A or Type B plug

A.12 Ports

Ethernet	10/100Base-T port for remote configuration and IP packet forwarding
Serial	<ul style="list-style-type: none"> ♦ Serial Port 1: Rx, Tx, RTS, CTS, DTR, DSR, CD, RI ♦ Serial device power (pass through supply voltage)
External state-of-health	<ul style="list-style-type: none"> ♦ 4 user-defined 12-bit channels ♦ Data rate: configurable, options up to 1 sample per 5 seconds ♦ Input range for each channel: $\pm 2.0V$ DC <ul style="list-style-type: none"> • Uncalibrated accuracy: (maximum offset error $\pm 0.07V$, maximum gain error 2%) or (maximum error $\pm 0.11V$ from $-2V$ DC to $+2V$ DC) ♦ SOH power: 3.3V DC regulated, 10mA maximum

A.13 Power

Supply input voltage	9V to 36V DC
Power consumption (average typical)	<p>Typical configurations:</p> <ul style="list-style-type: none"> ♦ Buffered mode: 12V, 3-channel at 100sps, <100µsec timing precision: <ul style="list-style-type: none"> • ~750mW recording to CF card • ~800mW recording to IDE hard drive ♦ Communications mode: 12V, 3-channel at 100sps, <100µsec timing precision, real-time Ethernet or serial communication: <ul style="list-style-type: none"> • ~2.3W typical continuous recording to CF card ♦ All systems operational including colour graphics display screen, continuous recording to hard drive <ul style="list-style-type: none"> • ~3.3W <p>In any mode:</p> <ul style="list-style-type: none"> ♦ For common mode range configured to Extended, add 40mW ♦ For GPS configured to Always On, add 200mW
Protection	Configurable low voltage disconnect and restart, reverse battery and overvoltage protection, short circuit and overcurrent protected by resettable electronic circuit breakers.
Isolation	Supply power is isolated from signal ground
Earth	Predrilled hole for M4 x 5 earth lug screw
Low/high voltage disconnect	Software configurable
Peripheral power output	<p>Typical over-current limit threshold</p> <ul style="list-style-type: none"> ♦ Sensor (SEN_V+, SEN_RTN): 1000mA ♦ NMX Bus (NMXBUS, NMXBUS_RTN): 1000mA ♦ Serial (S_PWR+, S_PWR-): 750mA

A.14 Environmental

Operating temperature	For CompactFlash recording option: <ul style="list-style-type: none"> ♦ -20°C to 60°C For IDE disk drive recording option: <ul style="list-style-type: none"> ♦ 5°C to 55°C
Storage temperature	-40°C to 70°C
Humidity	0 to 100% non-condensing with media door closed, under 90% with media door open
Operating altitude	<ul style="list-style-type: none"> ♦ For IDE hard drive, -60m to 3000m (-200 feet to 10000 feet) ♦ CompactFlash card, no limit
Dimensions	Width = 147mm, Length= 264mm, Depth = 60mm
Weight	1.8 kg
Construction	Machined aluminum case
Weather resistance	IP67 with the following conditions met <ul style="list-style-type: none"> ♦ Media door is closed. ♦ Connectors are either in use or sealed with the optional factory-installed dust caps or equivalent. ♦ Self-sealing pressure relief screw is torqued to hand-tight (about 1N·m or 9lb in).

A.15 Regulatory Compliance

Emissions	EN55022:1998 / CISPR22:1997 (modified); FCC Part 15:2004, Subpart B, Class A
Immunity	EN55024:1998 / CISPR24:1997 (modified)

Appendix B

Connector Pinouts

This appendix includes front face views of the Taurus connector receptacles and connector pinout descriptions. See [Section A.11 "Connectors"](#) on page 112 for connector specifications.



The 4-pin connector above the IDE drive slot is for factory use only. It is not described in this User Guide.

B.1 Sensor

Figure B-1 Sensor connector receptacle

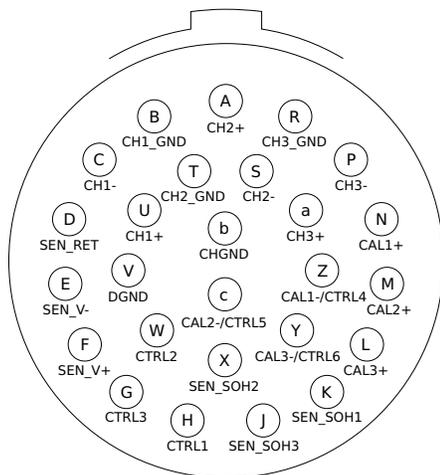


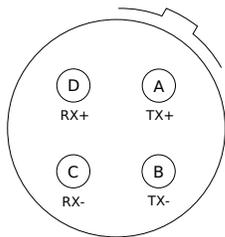
Table B-1 Sensor connector pinout

Pin	Name	Function	Details
U	CH1+	Channel 1 input	±20V, differential
C	CH1-		
B	CH1_GND	Channel 1 ground/shield	Connected to shield ground
A	CH2+	Channel 2 input	±20V, differential
S	CH2-		
T	CH2_GND	Channel 2 ground/shield	Connected to shield ground
a	CH3+	Channel 3 input	±20V, differential
P	CH3-		
R	CH3_GND	Channel 3 ground/shield	Connected to shield ground
K	SEN_SOH1	Sensor state of health input signals	±10V, single-ended Referenced to DGND
X	SEN_SOH2		
J	SEN_SOH3		
H	SEN_CTRL1	Sensor control signal outputs	0V / 5V / 12V / high impedance Referenced to DGND
W	SEN_CTRL2		
G	SEN_CTRL3		
N	SEN_CAL1+	Sensor calibration signal outputs	±4.5V single ended Referenced to DGND in voltage mode and to CALn- in current mode
M	SEN_CAL2+		
L	SEN_CAL3+		
Z	CAL1-/CTRL4	Sensor calibration signal return/ Sensor control signal outputs	Calibration signal return, or 0V / 5V / 12V / high impedance Referenced to DGND
c	CAL2-/CTRL5		
Y	CAL3-/CTRL6		
V	DGND	Digital ground	Digital ground
F	SEN_V+	Sensor power supply	Filtered, unregulated voltage
E	SEN_V-	Reserved for future use	N/C
D	SEN_RTN	Sensor power return	Switched, overcurrent protected
b	CHGND	Chassis	

Table B-4 Serial/USB connector pinout

Pin	Name	Function	Details
P	S1-RX	Serial Port 1 receive	RS-232
N	S1-TX	Serial Port 1 transmit	RS-232
L	S1-RTS	Serial Port 1 RTS	RS-232
D	S1-CTS	Serial Port 1 CTS	RS-232
B	S1-DTR	Serial Port 1 DTR	RS-232
C	S1-DSR	Serial Port 1 DSR	RS-232
E	S1-DCD	Serial Port 1 carrier detect	RS-232
R	S1-RI	Serial Port 1 ring indicator	RS-232
V	S_GND	Serial Port ground	
F	S2-RX	Serial Port 2 receive	RS-232
G	S2-TX	Serial Port 2 transmit	RS-232
H	S2-CTS/GP_IN	Serial Port 2 CTS /General purpose input	RS-232
S	S2-RTS/GP_OUT	Serial Port 2 RTS /General purpose output	RS-232
U	USB_D+	Host USB data+	
T	USB_D-	Host USB data -	
K	USB_VBUS	USB power	5V, 100mA
J	USB_GND	USB ground	
A	S_PWR+	Power for serial devices	Filtered, unregulated voltage, referenced to S_PWR-
M	S_PWR-	Power return	Switched, overcurrent protected

B.5 Ethernet

Figure B-5 Ethernet connector receptacle**Table B-5** Ethernet connector pinout

Pin	Function
A	Ethernet MTL-3 Transmit +
B	Ethernet MTL-3 Transmit -
C	Ethernet MTL-3 Receive -
D	Ethernet MTL-3 Receive +

B.6 External SOH



When there is a negative input voltage across External SOH values (pins A-G, for example) and if ground is connected to negative on the voltage supply, then an incorrect value appears for SOH. Ensure ground is floating from negative to prevent this error.

Figure B-6 External SOH connector receptacle

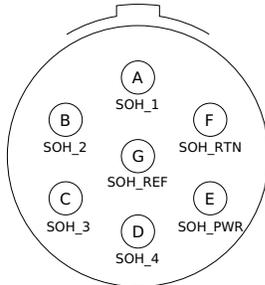
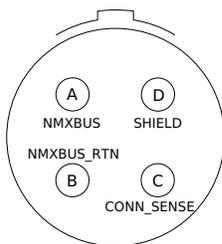


Table B-6 External SOH connector pinout

Pin	Function	Details
A	External SOH Port 1	±2.5V DC, referenced to pin G (SOH_REF)
B	External SOH Port 2	
C	External SOH Port 3	
D	External SOH Port 4	
G	External SOH reference	
E	External SOH power	3.3V, 10mA
F	External SOH power return	

B.7 NMXbus

Figure B-7 NMXbus connector



receptacle

Table B-7 NMXbus connector pinout

Pin	Function
A	NMXbus power and signal; filtered, unregulated voltage
B	NMXbus power and signal return, switched, overcurrent protected
C	NMXbus cable connection sense, referenced to NMXBUS_RTN
D	NMXbus cable shield

B.8 USB



This connector description refers to the mini USB connector socket in the media bay.

Figure B-8 USB connector receptacle

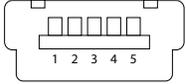


Table B-8 USB connector pinout

Pin	Function	Details
1	Standard USB power	+5V DC, 100mA
2	Data -	
3	Data +	
4	On-The-Go Sense	
5	USB ground	

Appendix C

Seismometer-Taurus

Interconnection

This appendix describes considerations and requirements for connecting the Taurus to a seismometer using the Nanometrics Trillium seismometers as an example. The principles apply in general to connecting high-performance seismometers to high-resolution Digitizers.



The Taurus is designed for best dynamic range performance when used with seismometers with differential outputs. For more information, see [Section C.5 "Taurus Operation with Single-Ended Inputs"](#) on page 126.

C.1 Circuit Description

C.1.1 Taurus

High-resolution Digitizers will always have differential input circuits; however, they will differ in their input impedance, RF suppression, and common-mode rejection. It is also important to determine whether or not the power supply is isolated.

The Taurus input stage has an input impedance of 43.07 k Ω (low impedance mode) or 9.4 M Ω (high impedance mode). It has a typical common-mode range of approximately ± 0.78 V (Normal) or ± 1.8 V (Extended) with respect to the case.

The front end is designed with excellent RF suppression so that the Taurus can be operated in the presence of radios and cell phones through the use of properly designed cables. The Taurus power supply is completely isolated from the rest of the electronics and the case.

The Taurus also provides state-of-health inputs and control, calibration, and sensor power outputs.

C.1.2 Sensors

High-performance active sensors always have differential output stages. Other active sensors sometimes have single-ended output stages. Passive seismometers have an isolated output coil. Active sensor power supplies can be isolated or not.

The Trillium 240 seismometer output is a balanced differential output with a clip level of 16 V peak-to-peak and an output impedance of 300 Ω (150 Ω each output). The Trillium seismometers power supply is completely isolated from the rest of the electronics and the case.

The Trillium seismometers also provide mass position outputs and a calibration input. For the Trillium 40 seismometer, active-low control inputs have three purposes: to act as calibration enable inputs, to configure the output signals (UVW or XYZ), and to select the short or long period frequency response. For the Trillium 120P seismometer, these inputs are active-high.

C.2 Shielding

Sensor cables must be designed for good EMI shielding. This is most easily accomplished using double-shielded twisted-pair cables as shown in [Figure C-1 "Typical passive sensor cable design"](#) on page 123 and [Figure C-2 "Typical active sensor cable design"](#) on page 124.

The twisted-pair cables provide magnetic shielding:

- The inner shield grounded at the Taurus provides good electric field shielding
- The continuous outer shield provides good high-frequency RF shielding.

The outer shield must be earthed for safety.



For optimal RF shielding, the outer shield should make a continuous connection with the shells of the connectors at both ends.

C.3 Grounding

C.3.1 General Considerations

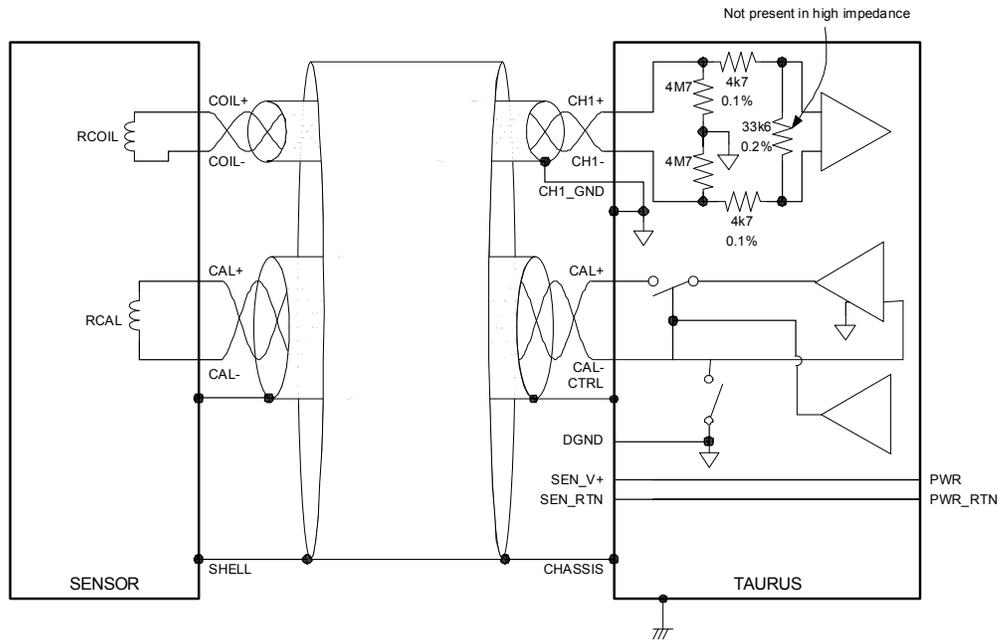
The Taurus and sensor cases must always have a low-resistance path to ground for safety. However, directly earthing both instruments will result in a ground loop. When the Taurus and sensor are far apart, the differences in ground potential will cause spurious signals to appear unless the loop is broken. The solution is to earth the Taurus case and isolate the sensor case or to isolate the Taurus case and earth the sensor case.

Usually the simplest solution is to earth the Taurus as shown in [Figure C-1 "Typical passive sensor cable design"](#) on page 123 and [Figure C-2 "Typical active sensor cable design"](#) on page 124. A hole pre-drilled for an M4 x 5 screw is provided on the side of the Taurus case for this purpose (see [Figure 4-2 "Hole for grounding lug screw"](#) on page 43). The Trillium seismometers have stainless steel adjustable feet, which when mounted directly onto dry rock or concrete provide a high resistance to ground. In wet environments, it might be necessary to mount the sensor on a plate of glass embedded in sand or to earth the sensor and isolate the Taurus case. Some sensors might have no chassis connection at the connector. In this case, the sensor and Taurus must be earthed separately.

C.3.2 Passive Sensors

For a passive sensor, connect the output and calibration coils as shown in [Figure C-1](#) and [Table C-1](#).

Figure C-1 Typical passive sensor cable design



The 4.7 MΩ input resistors at the input of the Taurus ensure that the common-mode voltage is negligible.

Table C-1 Typical passive sensor wiring list

From			To			Colour	Run
Connector	Pin*	Name	Connector	Pin	Name		
P1		COIL+	P2	U	CH1+	RED	1
P1		COIL-	P2	C	CH1-	BLK	1
			P2	B	CH1_GND	DRAIN	1
P1		CAL+	P2	N	SEN_CAL1+	WHT	2
P1		CAL-	P2	Z	CAL1-/CTRL4	BLK	2
P1		SHELL	P2	b	CHGND	DRAIN	2
P1		SHELL	P2	b	CHGND	BRAID	

* Pinout depends on the passive sensor that is selected.



In [Table C-1](#), P1 is the sensor connector and P2 is the Taurus connector. The Colour and Run columns are used to indicate which signals are paired together and how the shields are connected.

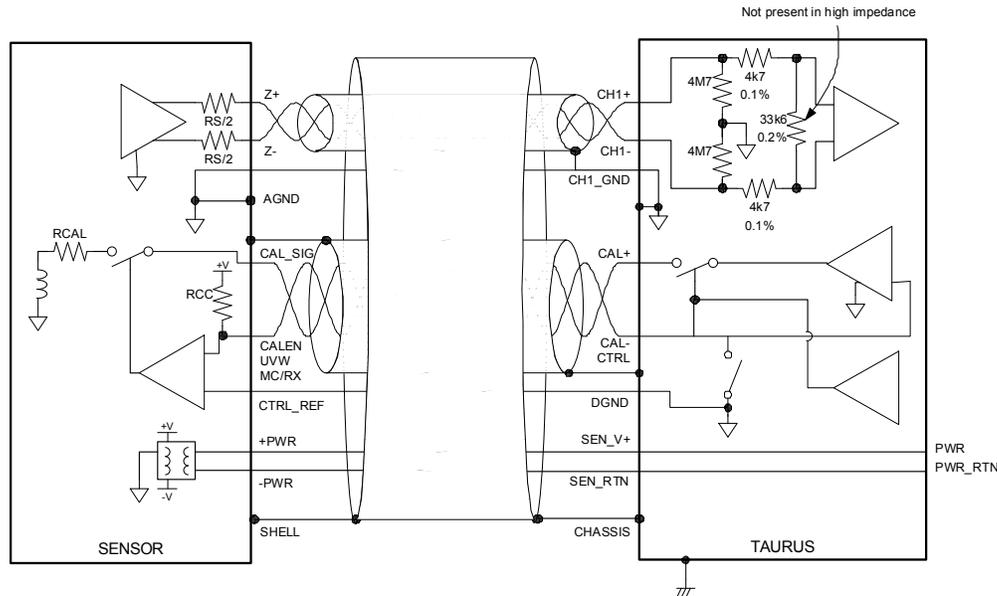
DRAIN refers to the drain wire of the shield of the twisted pair indicated in the Run column and BRAID refers to the overall braided shield of the cable.

C.3.3 Active Sensors

Figure C-2 shows a typical cable design for an active sensor with a differential output. Only one channel is shown and the mass position state-of-health connections have been omitted.

A typical wiring list is given in Table C-2. Pinouts given are for the Trillium seismometer and the Taurus.

Figure C-2 Typical active sensor cable design



When the sensor or Taurus power supplies are isolated, there is nothing to constrain the common-mode voltage of the sensor outputs with respect to the Taurus ground. For optimal shielding performance, the Taurus channel grounds are connected to the drain wires of the inner shields at one end of the cable only. Therefore, it is of critical importance that the analog ground of the sensor (AGND) is connected separately to the analog ground of the Taurus (CH1_GND). The other two Taurus channel grounds (CH2_GND and CH3_GND) should only be connected to their respective shield drain wires and not to AGND.

The control signal reference (CTRL_REF) serves as the reference voltage for all of the Trillium sensor control signals (U_CALEN, V_CALEN, W_CALEN, UVW and MC). This should be connected to the appropriate ground for the control signal outputs on the Taurus. In the case of the Taurus, this is the digital ground (DGND).

Table C-2 Typical active sensor wiring list

From			To			Colour*	Run
Connector	Pin	Name	Connector	Pin	Name		
P1	L	Z+/W+	P2	U	CH1+	RED	1
P1	M	Z-/W-	P2	C	CH1-	BLK	1
			P2	B	CH1_GND	DRAIN	1
P1	N	Y+/V+	P2	A	CH2+	WHT	2
P1	A	Y-/V-	P2	S	CH2-	BLK	2

Table C-2 Typical active sensor wiring list (Continued)

From			To			Colour*	Run
Connector	Pin	Name	Connector	Pin	Name		
			P2	T	CH2_GND	DRAIN	2
P1	P	X+/U+	P2	a	CH3+	GRN	3
P1	B	X-/U-	P2	P	CH3-	BLK	3
			P2	R	CH3_GND	DRAIN	3
P1	T	CAL_SIG	P2	N	CAL1+	BLU	4
P1	U	W_CALEN	P2	Z	CAL1-/CTRL4	BLK	4
P1		SHELL	P2		SHELL	DRAIN	4
P1	J	V_CALEN	P2	c	CAL2-/CTRL5	YEL	5
P1	K	U_CALEN	P2	Y	CAL3-/CTRL6	BLK	5
P1		SHELL	P2		SHELL	DRAIN	5
P1	S	W_MP	P2	K	SEN_SOH1	BRN	6
P1	F	V_MP	P2	X	SEN_SOH2	BLK	6
P1		SHELL	P2		SHELL	DRAIN	6
P1	E	U_MP	P2	J	SEN_SOH3	ORG	7
P1	V	AGND	P2	B	CH1_GND	BLK	7
P1		SHELL	P2		SHELL	DRAIN	7
P1	H	+PWR	P2	F	SEN_V+	RED	8
P1	G	-PWR	P2	D	SEN_RTN	WHT	8
P1		SHELL	P2		SHELL	DRAIN	8
P1	D	UVW/TX	P2	H	CTRL1	RED	9
P1	C	MC/RX	P2	W	CTRL2	GRN	9
P1	R	CTRL_REF	P2	V	DGND	DRAIN	9
P1		SHELL	P2	b	CHGND	BRAID	
P2	N	CAL1+	P2	M	CAL2+		
P2	M	CAL2+	P2	L	CAL3+		

* Depends on cable type: This example shows Nanometrics cable 13050-x.



In [Table C-2](#), P1 is the sensor connector and P2 is the Taurus connector. The Colour and Run columns are used to indicate which signals are paired together and how the shields are connected.

DRAIN refers to the drain wire of the shield of the twisted pair indicated in the Run column and BRAID refers to the overall braided shield of the cable.

C.4 Other Considerations

Some other factors to consider when designing sensor cables are as follows:

- Ensure that the cable length does not cause the sensor requirements for capacitive loading to be exceeded.
- Ensure that the cable is not so long that the peak current requirement of the sensor results in a voltage drop that is so large that the power supply input voltage is below the minimum required at the sensor.
- Ensure that the cable is watertight.
- Check the cable electrically after assembly. In particular, ensure that the individual and overall shields are not shorted together unless so specified.
- Make sure cables are labelled with correct drawing numbers and revisions.
- Make sure the Taurus is configured so that the default states of the control lines put the sensor in the state you want it to be in.

C.5 Taurus Operation with Single-Ended Inputs

The Taurus is designed for best dynamic range performance when used with sensors with differential outputs. Over a limited voltage range, common-mode signal components induced into the input cable are rejected (for example, unwanted noise). However, common-mode signals greater than ± 0.78 V (with respect to chassis ground) cause distortion. The maximum single-ended signal before distortion, V_{max} , is computed from the maximum common-mode voltage, $V_{cm_{max}}$, using:

$$V_{max} = 2 \times V_{cm_{max}} = 2 \times 0.78 = 1.56\text{V}$$

The common-mode range can be extended to ± 1.8 V.

C.5.1 Input Range and Gain for a Single-Ended Signal

A single-ended signal can be considered as the sum of differential (*dif*) and common-mode (*CM*) signals.

Assume (V_{CM}) is the common-mode input, to both positive and negative terminals, and $V_{dif}/2$ and $(-V_{dif})/2$ are the differential inputs. If these are the components of a single-ended signal and the negative terminal is connected to ground return, then $V_{CM} + (-V_{dif}/2) = 0$. Therefore, $V_{CM} = V_{dif}/2$.

At the positive terminal, with $V_{CM} + V_{dif}/2$ referred to ground, the differential input is $(V_{CM} + V_{dif}/2) - (V_{CM} + ((-V_{dif})/2)) = V_{dif}$.

Therefore, gain to a single-ended signal is the same for differential and the common-mode component is half of the single-ended input.

Appendix D

Filter Response

D.1 Response Overview

Analog signals connected to the Taurus are filtered using a first order low pass antialias filter before being sampled at 30 kHz. This data is later low pass filtered using a 3 to 4 stage FIR (Finite Impulse Response) filter and decimated to the output sample rate. Depending on the requested sample rate, different filters are used and a different number of filter stages are required. The output bandwidth will always be 0.4 times the output sample rate.

The low frequency response is also configurable using the DC removal IIR (Infinite Impulse Response) filter. With no filter, the response is set to DC (0 Hz). With the DC removal filter enabled, it can be set to a number of frequencies within a range.

D.2 System Filter Values

This section describes the transfer functions of the Digitizer module components.

D.2.1 Analog Low Pass Antialias Filter

The analog antialias filter is a first order low pass filter, with a corner frequency that is dependent on whether the Taurus input impedance is set to low impedance (Low-Z) or high impedance (High-Z).

D.2.1.1 Transfer Function

$$F_{(j\omega)} = \frac{1}{R \cdot C \cdot j\omega + 1}$$

where

- ♦ $C = 1.0 \times 10^{-8} \text{F}$
- ♦ $R = \frac{1}{\frac{1}{33600} + \frac{1}{(9600 + Z)}} \Omega$ for low impedance mode
- ♦ $R = (9600 + Z) \Omega$ for high impedance mode
- ♦ Z is the output impedance of the sensor

D.2.1.2 Corner Frequency

The corner frequency f_0 is therefore

$$f_0 = \frac{1}{2\pi RC} \text{Hz}$$

If the sensor output impedance is negligible, then

- ♦ $f_0 = 2132\text{Hz}$ in low impedance mode
- ♦ $f_0 = 1659\text{Hz}$ in high impedance mode

D.2.2 Digital FIR Low Pass Filters

The 3 to 4 stage digital FIR filter low pass-filters and decimates the data to the output sample rate.

D.2.2.1 Transfer Function

$$y(n) = \sum_{i=0}^{N-1} c(i) \cdot x(n-i)$$

where

- ♦ $y(n)$ is the output sample
- ♦ $x(n-i)$ is an input sample
- ♦ $c(i)$ is a FIR coefficient
- ♦ N is the number of coefficients

D.2.2.2 Coefficients

Table D-1 shows the individual digital filter stages, the associated decimation for each output sample rate, and the cumulative filter delay. You can get the filter coefficient sets from the file FIR_filter_coefficients.txt, which is located in the doc folder on the Taurus CD.

Table D-1 Digital filter stages and associated decimation

Output sample rate	Filter parameter	Stage				Cumulative filter delay (seconds)
		1	2	3	4	
10	# of Coefficients	213	177	113	223	6.172200
	Decimation	20	15	5	2	
20	# of Coefficients	165	187	113	223	3.104233
	Decimation	15	10	5	2	
40	# of Coefficients	177	71	113	223	1.547933
	Decimation	15	5	5	2	
50	# of Coefficients	203	245	223	—	1.194700
	Decimation	20	15	2	—	
80	# of Coefficients	165	63	497	—	0.638233
	Decimation	15	5	5	—	
100	# of Coefficients	165	187	223	—	0.604233
	Decimation	15	10	2	—	
120	# of Coefficients	59	69	113	223	0.515800
	Decimation	5	5	5	2	
200	# of Coefficients	173	95	223	—	0.303867
	Decimation	15	5	2	—	
250	# of Coefficients	187	73	223	—	0.243100
	Decimation	15	4	2	—	
500	# of Coefficients	123	65	223	—	0.123700
	Decimation	10	3	2	—	

D.2.3 Digital IIR High Pass Filter

The digital IIR high pass filter is used for the optional DC removal feature. DC removal, if used, is applied after the digital FIR filtering.

D.2.3.1 Transfer Function

$$y(n) = K \cdot [x(n) - x(n-1)] + F_1 \cdot y(n-1)$$

where

- ♦ $y(n)$ is the current output sample
- ♦ K is the filter gain
- ♦ $x(n)$ is the current input sample
- ♦ $x(n-i)$ is the previous input sample
- ♦ F_1 is the filter coefficient
- ♦ $y(n-i)$ is the previous output sample

D.2.3.2 Coefficients

The IIR filter is implemented as a first order high pass IIR filter using the following coefficients calculated at runtime:

$$F_1 = \frac{1 - \left(\frac{\pi \cdot f}{F_S}\right)}{1 + \left(\frac{\pi \cdot f}{F_S}\right)}$$

$$K = \frac{1}{1 + \left(\frac{\pi \cdot f}{F_S}\right)}$$

where

- ♦ F_S is the output sample rate
- ♦ f is the -3 dB corner frequency of the filter (configurable, see the documentation for the NMXbus-enabled device)

The time constant (TC) of the filter can be calculated as follows:

$$TC = \frac{1}{2\pi \cdot f}$$

Appendix E

Open Source/Free Software Information

Taurus software includes open source/free software components. Links to the licence information for each component is provided in [Table E-1](#).

You can request the source code from Nanometrics for derived components. The remaining open source/free code can be obtained from the original developers.

E.1 Availability of Open Source/Free Software Components

Table E-1 List of open source/free software components

Software component	Source code available from Nanometrics	License information
Das U-Boot	Yes	GNU General Public License
Epson video driver	Yes	GNU General Public License
JFFS2 driver	Yes	GNU General Public License
Konqueror Embedded	Yes	GNU General Public License
Linux Kernel	Yes	GNU General Public License
Qt Embedded Free	Yes	GNU General Public License
JSAP	Yes	GNU Lesser General Public License Version 3
Apache Commons	No	The Apache Software Foundation
Bouncy Castle	No	The Legion Of The Bouncy Castle
Jetty	No	The Apache Software Foundation
lwIP	No	The lwIP TCP/IP Stack
md5.js	No	Javascript MD5
OpenSSH	No	OpenSSH

Appendix F

Firmware Upgrade Procedures

F.1 Before You Upgrade

- ◆ Ensure that the Taurus is connected to a local network (LAN) using the supplied Ethernet cable or equivalent.
- ◆ Make sure that the computer you will use to upgrade the Taurus has a Web browser and access to the Internet.
- ◆ If you want to upgrade the firmware for a Trident 305, make sure it is connected to the Taurus.
- ◆ Contact Technical Support to obtain a Taurus firmware upgrade file (.tgz) and save it to the computer you will use to upgrade the Taurus. For more information, see [Contacting Technical Support](#) on page 175.
- ◆ Check the release notes for any upgrade instructions specific to the firmware version you are upgrading to. For example, for some upgrades it is recommended that you delete the Store before and after you upgrade. These special instructions will be included in the release notes for the firmware version.

F.2 Upgrading from Version 2.x to Version 3.x

When you install new firmware, the Taurus reboots and uses that new firmware as the active firmware. However, the next time the Taurus reboots it will revert to the default firmware. You can change this by setting the new firmware as the default after you install it. The following steps explain how to install new firmware and set it as the default.

To upgrade from version 2.x to version 3.x

1. Click  and select **Status** from the main menu.
2. If required, enter a user name and password.
For more information, see [Section 2.3.1 "Logging In"](#) on page 24.
3. Verify that the Taurus is running in Communications mode.
For more information, see [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27.
4. Verify that the Ethernet mode is set to **Static IP** to ensure that the IP address of the Taurus does not change when it reboots after the firmware upgrade.
For more information, see [Section 6.2.1 "Configuring Ethernet Settings"](#) on page 54.
5. Click  and select **Upgrade** from the main menu.
6. Click **Browse**, select the .tgz file you downloaded, and click **Open**.

7. Click **Upload**.



Uploading the file over a LAN might time out if you are using a proxy server to connect to the Internet. If this happens, you can change network settings to bypass the proxy server for local addresses.

8. Ensure that the firmware version you want to install is selected in the list and click **Install** to install the firmware and restart the Taurus using the new firmware.

The Taurus will install the firmware (the files should finish installing within about 15 to 20 minutes) and then reboot automatically. The Taurus will take 2 or 3 minutes to finish rebooting.

Once the firmware is installed and the Taurus has rebooted, the new firmware is active but it is not yet the default. You can run the Taurus with the active firmware but it will revert to the default firmware after a reboot. Steps 10 to 12 show you how to set the active firmware as the default firmware.



You can view the active version and default version on the Upgrade page.

9. After the Taurus has rebooted, clear your Web browser's temporary files (cache) before you access the Taurus user interface over an IP connection.

10. Click  and select **Upgrade** from the main menu.

11. If required, enter a user name and password.

For more information, see [Section 2.3.1 "Logging In"](#) on page 24.

12. Click **Commit** to set the currently running version of the firmware as the default firmware.

The default firmware is the firmware that the Taurus will use each time it reboots. You should set each new firmware upgrade as the default after you install it.



If required, you can select a firmware upgrade file in the list and click **Delete** to remove it from the Taurus.

You can also click **Revert** to reboot the Taurus and run it with the default version of the firmware.

F.3 Upgrading from Version 3.x to Version 3.x

When you install new firmware, the Taurus reboots and uses that new firmware as the active firmware. However, the next time the Taurus reboots it will revert to the default firmware. You can change this by setting the new firmware as the default after you install it. The following steps explain how to install new firmware and set it as the default.

To upgrade from version 3.x to version 3.x

1. Click  and select **Status** from the main menu.
2. If required, enter a user name and password.
For more information, see [Section 2.3.1 "Logging In"](#) on page 24.
3. Verify that the Taurus is running in Communications mode.
For more information, see [Section 2.4 "Selecting the Taurus Running Mode"](#) on page 27.
4. Verify that the Ethernet mode is set to **Static IP** to ensure that the IP address of the Taurus does not change when it reboots after the firmware upgrade.
For more information, see [Section 6.2.1 "Configuring Ethernet Settings"](#) on page 54.
5. Click  and select **Upgrade** from the main menu.
6. Click **Browse**, select the .tgz file you downloaded, and click **Open**.
7. Click **Upload**.



Uploading the file over a LAN might time out if you are using a proxy server to connect to the Internet. If this happens, you can change network settings to bypass the proxy server for local addresses.

8. Ensure that the firmware version you want to install is selected in the list and click **Install** to install the firmware and restart the Taurus using the new firmware.

The Taurus will install the firmware and then reboot automatically. The Taurus will take 2 or 3 minutes to finish rebooting.

Once the firmware is installed and the Taurus has rebooted, the new firmware is active but it is not yet the default. You can run the Taurus with the active firmware but it will revert to the default firmware after a reboot. Steps [10](#) to [12](#) show you how to set the active firmware as the default firmware.



You can view the active version and default version on the Upgrade page.

9. After the Taurus has rebooted, clear your Web browser's temporary files (cache) before you access the Taurus user interface over an IP connection.
10. Click  and select **Upgrade** from the main menu.
11. If required, enter a user name and password.
For more information, see [Section 2.3.1 "Logging In"](#) on page 24.

12. Click **Commit** to set the currently running version of the firmware as the default firmware.

The default firmware is the firmware that the Taurus will use each time it boots. You should set each new firmware upgrade as the default after you install it.



If required, you can select a firmware upgrade file in the list and click **Delete** to remove it from the Taurus.

You can also click **Revert** to reboot the Taurus and run it with the default version of the firmware.

Appendix G

UI Pages

- ◆ [Status](#)
- ◆ [Waveform](#)
- ◆ [SOH](#)
- ◆ Alerts — See [Section 3.3.4 “Alert Messages”](#) on page 37
- ◆ [Data Availability](#)
- ◆ Data Retrieval — See [Chapter 10 “Viewing and Retrieving Data”](#)
- ◆ [Timing](#)
- ◆ Sensor — See [Section 8.1 “Monitoring Sensor Operation”](#) on page 69
- ◆ [Store Tools](#)
- ◆ [System Info](#)
- ◆ Configuration — See [Appendix H “Configuration UI Pages”](#)
- ◆ Upgrade — See [Appendix F “Firmware Upgrade Procedures”](#)
- ◆ Log Off — See [Section 2.3 “Logging In and Off”](#) on page 23
- ◆ Shutdown — See [Section 2.2 “Starting Up and Shutting Down”](#) on page 21



You can click the Pause automatic refresh button  at the top of the Status, Waveform, SOH, Timing, and Sensor pages to stop the page from refreshing automatically every 5 seconds.

The page will also stop refreshing automatically if you are inactive for more than 30 minutes.

You can click the Start automatic refresh button  to start automatic refreshing again.

G.1 Status

Table G-1 Status page overview

	Description
Mode	The mode the Taurus is currently running in. For more information, see Section 2.4 "Selecting the Taurus Running Mode" on page 27.
Store Time Left/Avg Data Stored	The estimated number of days of recording space remaining in the active Store based on all of the data currently in the Store (and therefore the aggregate sample rate of previously recorded data). Once the Store has reached its configured capacity or has used all of the available space on the media and has started to record over old data, the Store Time Left changes to Avg Data Stored and the value changes to a continuously recalculated average quantity of data in the Store, expressed in units of time.
Store Size	The amount of total storage space used. For more information, see Section 9.1 "Data Stores" on page 81.
IP	The current Ethernet IP address and subnet mask of the Taurus. The IP address is in dotted decimal format and the subnet mask is in mask width format.
Time	The current time according to the Controller The Controller resynchronizes its time to the system clock continuously when it is running. For more information, see Section 2.2.1 "Starting the Controller" on page 21.
Voltage	The current power supply level in volts For more information on configuring the power supply, see Section H.9 "Power Manager" on page 164.
Power	The average power consumption of the Taurus in watts This includes power consumption of any externally connected devices such as a sensor, serial device, or a device connected to the external SOH.
Packets	The number of data packets recorded to the Store since the Controller was started. For more information, see Section 2.2.1 "Starting the Controller" on page 21.
Timing	The current timing uncertainty of the system clock
Status bar	The status bar provides a high-level overview of the overall status of the Taurus. For more information, see Section 3.3.1 "Status Bars" on page 35.
Waveform images	Shows the following information for the Taurus and each Trident 305 connected to the Taurus: <ul style="list-style-type: none"> • Instrument ID (such as Taurus 0838 or Trident 305 0005) • Number of enabled channels at the sample rate (such as 3 at 500sps) • Internal temperature (in degrees Celsius) • Time series data in near real-time for each displayed channel <p>Notes:</p> <p>If no Trident 305s are connected to the Taurus, all of the configured output channels of the Taurus are shown.</p> <p>If one or more Trident 305s are connected to the Taurus, then the first enabled channel (the Z channel by default) is shown for the Taurus and for each Trident 305.</p>

G.1.1 Status Details Page

All status bars are yellow when the Taurus is powering up or running diagnostics.

Table G-2 Status details page overview

Status bar	Description		
Timing	<p>The timing status bar indicates the status of the system clock and its inputs and it provides a link to the Timing page.</p> <p>Notes:</p> <ul style="list-style-type: none"> ◆ System time starts from zero when the Taurus is powered on and has not been set properly until the time status has been green at least once since power on. ◆ PLL state < Coarse Lock = either Free Running or No Lock 		
	Colour	Text	Indicates
	Green	Time OK	<ul style="list-style-type: none"> ◆ PLL state has not reached Coarse Lock and Time Uncertainty < 100µs. -OR- ◆ PLL state has reached Coarse Lock or better and Time Error < 100µs.
	Yellow	GPS Init	<ul style="list-style-type: none"> ◆ System time has not been set yet after power on, the GPS is on, the PLL state has not reached Coarse Lock, and the GPS is on for shorter than the initialization time limit.
	Red	No Antenna	<p>Antenna open is detected.</p> <p>This is a hardware fault condition even if Taurus time is OK. The Lassen iQ GPS receiver can detect an antenna open condition but the Lassen SQ GPS receiver cannot. If your Taurus uses the Lassen SQ GPS receiver, this status report is not available.</p>
		Antenna Short	<p>Antenna short is detected.</p> <p>This is a hardware fault condition even if Taurus time is OK.</p>
		GPS Off	<ul style="list-style-type: none"> ◆ System time has not been set yet after power on and the GPS is off. -OR- ◆ Timing status was green at least once, Time Uncertainty >= 100µs, and GPS is off.
		GPS Failed	<ul style="list-style-type: none"> ◆ System time has not been set yet after power on, PLL state has not reached Coarse Lock, and the GPS has been switched on for longer than the initialization time limit. -OR- ◆ Timing status was green at least once, Time Uncertainty >= 100µs, and the GPS is on.
Bad Time		<ul style="list-style-type: none"> ◆ System Time has not been set yet after power on, the GPS is on, PLL state has reached Coarse Lock or better, and Time Error >= 100µs. -OR- ◆ Timing status was Green at least once and PLL state >= Coarse Lock, Time Error >= 100µs. 	

Table G-2 Status details page overview

Status bar	Description
Store	<p>The Store status bar indicates the status of the Store and the active recording medium and provides a link to the Store Tools page:</p> <ul style="list-style-type: none"> ♦ Green colour – The Store is ready for data recording. ♦ Red colour – The Store is missing or corrupt, the media is missing (not installed), or there is not enough free space to accommodate the size that the current Store was configured for. ♦ Yellow colour – The Store is not ready for data recording because it is being reindexed, resized, created, reformatted, or re-created.
Media Door	<p>The media door status bar indicates the status of the media door:</p> <ul style="list-style-type: none"> ♦ Green colour – The media door is closed. ♦ Red colour – The media door is open. <p>Note: The media door should be closed when the Taurus is operating.</p>
Firmware	<p>The Firmware status bar indicates the current status of the firmware and provides a link to the System Info page:</p> <ul style="list-style-type: none"> ♦ Green colour – The firmware versions are okay. ♦ Red colour – The firmware versions of the subcomponents do not match.
Tridents	<p>The Trident status bar indicates if the Taurus detects all of the Trident 305s that are expected to be connected to the Taurus. You can configure the expected number on the Configuration > General page:</p> <ul style="list-style-type: none"> ♦ Green colour – The expected number of Tridents is detected. ♦ Red colour – Number of Tridents detected does not match the expected number.
Ethernet	<p>The Ethernet status bar indicates the status of the Ethernet network:</p> <ul style="list-style-type: none"> ♦ Green colour – Ethernet networking is enabled and a link is established or there is no link and the Taurus is in Buffered mode. ♦ Red colour – Ethernet networking is enabled but there is no link. <p>You can configure Ethernet options on the Configuration > Communications page and on the Configuration > Communications > Ethernet page.</p> <p>Notes:</p> <ul style="list-style-type: none"> ♦ If the Ethernet port has been disabled, the Ethernet status bar is not visible on the Status details page.
Power	<p>The Power status bar indicates the status of the current draw of external devices:</p> <ul style="list-style-type: none"> ♦ Green colour – The power usage of external devices is within tolerance. ♦ Red colour – An external device (on either the serial or the sensor connector) has drawn too much current and has been shut off. <p>Sensor power can be turned back on (assuming the fault condition has been fixed) on the Sensor page (see Section 8.2 "Controlling Sensors" on page 70). The Taurus must be power cycled to restore serial power once it has been tripped.</p>

Table G-2 Status details page overview

Status bar	Description											
Sensor	The Sensor status bar indicates the sensor power status and provides a link to the Sensor page (see Section 8.1 "Monitoring Sensor Operation" on page 69). You can configure sensors on the Configuration > Sensor Library page and you can control and monitor sensors on the Sensor page.											
	<table border="1"> <thead> <tr> <th>Colour</th> <th>Text</th> <th>Indicates</th> </tr> </thead> <tbody> <tr> <td>Green</td> <td>OK</td> <td> <ul style="list-style-type: none"> The sensor is configured as active, is powered, and is drawing the proper current. -OR- The sensor is configured as passive and is not powered. </td> </tr> <tr> <td rowspan="2">Red</td> <td>No Power</td> <td>The sensor is configured as active but is not powered.</td> </tr> <tr> <td>Powered</td> <td>The sensor is configured as passive but is powered.</td> </tr> </tbody> </table>	Colour	Text	Indicates	Green	OK	<ul style="list-style-type: none"> The sensor is configured as active, is powered, and is drawing the proper current. -OR- The sensor is configured as passive and is not powered. 	Red	No Power	The sensor is configured as active but is not powered.	Powered	The sensor is configured as passive but is powered.
	Colour	Text	Indicates									
	Green	OK	<ul style="list-style-type: none"> The sensor is configured as active, is powered, and is drawing the proper current. -OR- The sensor is configured as passive and is not powered. 									
Red	No Power	The sensor is configured as active but is not powered.										
	Powered	The sensor is configured as passive but is powered.										
Config	The config status bar indicates if the latest configuration changes have been committed and provides a link to the Configuration page: <ul style="list-style-type: none"> Green colour – Latest configuration changes have been committed. Red colour – Latest configuration changes have not been committed. Select the Commit button on the Configuration page to commit the latest configuration changes.											

G.2 Waveform

The Waveform page shows a waveform in near-real time for each channel with DC offset correction. You can view a single channel at a time or all three channels. You can also adjust the scale.



If you have a Trident 305 connected to the Taurus, you can view waveform information for that Trident by selecting the arrow ▼ in the upper-right corner of the Waveform page and selecting the Trident 305 from the list.

Table G-3 Waveform page overview

	Description
Time	The time scale width in seconds The default setting is 30.
Scale	The amplitude scale in counts The current scale setting is shown on the upper-right corner of the waveform. After about 1 minute from start up of the Controller, the waveform will show AC RMS and DC average. On a single-waveform display, the minimum and maximum values of the visible data are also shown as a numeric value: <ul style="list-style-type: none"> S = vertical scale of the channel window MIN = smallest sample value of the samples MAX = largest sample value of the samples The default setting is Auto.

Table G-3 Waveform page overview

	Description
C	The waveform currently displayed. You can view one waveform at a time (Z, N, or E) or view all channel waveforms simultaneously (All).

G.3 SOH

The SOH page shows a summary of the state of health of the Taurus at the time shown. You can also download detailed SOH information as .csv files (see [Section 10.4 "Extracting State of Health Data"](#) on page 95).



If you have a Trident 305 connected to the Taurus, you can view SOH information for that Trident by selecting the arrow ▼ in the upper-right corner of the SOH page and selecting the Trident 305 from the list.

Table G-4 SOH page overview

	Description
Temperature	The internal temperature of the Taurus, accurate to ± 2 °Celsius
Input Voltage	The power supply voltage, accurate to ± 0.2 V You can configure battery power settings on the Configuration > Power Manager page.
Serial	An estimate of the current drawn by a connected serial device.
NMXbus	An estimate of the current drawn by an external NMXbus device.
Sensor	An estimate of the current drawn by the connected sensor (for sensors that draw more than about 8 mA).
Controller	An estimate of the current drawn by the Taurus Controller.
Digitizer	An estimate of the current drawn by the Taurus Digitizer.
External SOH 1 /2/3/4	The voltage on the specified External SOH connector
Time	The last time the SOH was updated.

G.4 Data Availability

The Data Availability pages show graphical and text summaries of data availability for the instrument (Taurus or Trident 305) selected in the list in the upper-right corner of the page. You can also view data availability for all instruments in the list by selecting **All Instruments** from the list in the upper-right corner of the Data Availability page.

You can view graphical summaries of the time series data availability for each month, week, or day. You can also view text summaries with links to detailed availability information for each band of data. A band is a stream of packets that contains one or more channels. For time series data, each band contains one channel of data. For SOH data, each band contains multiple channels (such as temperature, voltage, and currents). Text summaries are available for both time series data and the other data types (such as SOH).



Select **Refresh** to refresh the data on the Data Availability pages.

G.4.1 Month

The Month page shows a calendar summary of time series data availability for the selected month. You can use the green arrows at the top of the page to change the month. If a day had data gaps, you can select it to view the graphical summary for that day.

G.4.2 Week

The Week page shows a graphical summary of the time series data availability for each channel for the selected week. You can use the green arrows at the top of the page to change the week. You can select a date to view the graphical summary for that day.

G.4.3 Day

The Day page shows a graphical summary of the time series data availability for each channel for the selected day. You can use the green arrows at the top of the page to change the day.

G.4.4 Text

There is one Text page for time series data and one for all other data. These pages show data availability and gap information.

A gap can be either a data gap (data packets are missing) or a time tear (a time jump with no missing packets: for example, caused by a time adjustment after an extended GPS reception outage) or both (for example, after the power has been disconnected for an extended period of time).

G.4.4.1 Time Series

The Time Series page shows a text summary of the following:

- The available time ranges of data for each time series channel (band)
- The number of data gaps and time tears
- The quantity of data as both units of time and as the percentage of space used in the Store.

You can select the band name links to view a page showing details about all gaps for that band (see [Time Series Band Pages](#) on page 144).

Time Series Band Pages

Each Times Series Band page shows details about availability for that band. The page shows

- The quantity of data as the percentage of space used in the Store
- The available time range of data
- The number of gaps (includes both data gaps and time tears)
- A list of all gaps that exceed the gap tolerance, with the number of packets missing (if that information is available) and the gap duration

You can select a gap tolerance for this band from the Gap Tolerance list. You can select the **All Channels** link to return to the main Time Series page.

G.4.4.2 Other Bands

Other data types include alert, configuration, log (Apollo, DSP, ARM), SOH, and triggers.

The Other page shows a text summary of the following:

- The available time ranges of data for each time series channel (band)
- The number of data gaps and time tears
- The quantity of data as both units of time and as the percentage of space used in the Store.

You can select the band name links to view a page showing details about all gaps for that band (see [Other Band Pages](#) on page 144).

Other Band Pages

Each Other Band page shows details about availability for that band. The page shows

- The quantity of data as the percentage of space used in the Store
- The available time range of data
- The number of gaps (includes both data gaps and time tears)
- A list of all gaps that exceed the gap tolerance, with the number of packets missing (if that information is available) and the gap duration

You can select a gap tolerance for this band from the Gap Tolerance list. You can select the **All Channels** link to return to the main Other page.

G.5 Timing

The Timing pages show the status of the system clock, GPS receiver, and GPS satellites; including a visual summary of the GPS satellite status in the form of a GPS map. There is a corresponding Timing status bar on the Status Details page (see [Section G.1.1 "Status Details Page"](#) on page 139). You can configure GPS and timing options on the Configuration > Digitizer > Timing page (see [Table H-17 "Timing settings"](#) on page 160).



You can download timing SOH information as .csv files (see [Section 10.4 "Extracting State of Health Data"](#) on page 95).

G.5.1 Timing

Table G-5 Timing page overview

	Description
Report Time	The current time of the system clock For more information, see Table 7-1 "Taurus time definitions" on page 65.
PLL State	The current status of the Phase Locked Loop (PLL) control system used to acquire the GPS signal The possible statuses are as follows: <ul style="list-style-type: none"> • Free running — The system clock is not being synchronized with GPS time • Fine lock — Small time corrections are being performed to synchronize the system clock with the GPS time, which is provided by the GPS receiver • Coarse lock — Large time corrections are being performed to synchronize the system clock with the GPS time, which is provided by the GPS receiver
Uncertainty	Uncertainty of report time (system time)
Time Error	The amount of time the report time (system time) differs from GPS Time For more information, see Table 7-1 "Taurus time definitions" on page 65.
DAC Count	The value used to calculate the time base.
Status	The satellite tracking status of the GPS receiver The possible statuses are as follows: <ul style="list-style-type: none"> • Off - The GPS receiver is off. • Doing fixes — The GPS receiver is doing position fixes. • No GPS time — The GPS receiver does not have GPS time yet. • Need to initialize — The GPS receiver needs to initialize. • PDOP too high — The PDOP is too high, which means that the GPS receiver will not generate a position calculation. • No satellites — The GPS receiver has not found any usable satellites. • One satellite — The GPS receiver has only found one usable satellite. • Two satellites — The GPS receiver has only found two usable satellites. • Three satellites — The GPS receiver has only found three usable satellites. • Satellites unusable — The chosen satellites are unusable for position calculation.
Satellites Used	The number of satellites used for position calculation
PDOP	Position Dilution of Precision A standard estimate of the GPS position precision based on the geometry of the visible satellites. A lower value indicates a more precise position calculation. The GPS receiver will not generate a solution if the PDOP is too high.

Table G-5 Timing page overview

	Description
TDOP	Time Dilution of Precision A standard estimate of the GPS time precision based on the geometry of the visible satellites. A lower value indicates a more precise position calculation.
Location	The current latitude, longitude, and elevation of the Taurus.

G.5.2 GPS Satellites

Table G-6 GPS satellites page overview

	Description
PRN	The Pseudo-Random Noise code used to identify each satellite.
Status	The signal acquisition status of that channel of the GPS receiver
Elev	The elevation angle of the satellite in degrees The elevation ranges from 0° to 90° (0° is parallel to the surface of the earth).
Azim	The azimuth of the satellite in degrees, measured clockwise from true north.
Signal	The strength of the signal in antenna measurement units (AMU) An AMU is a measure of signal to noise ratio. The conversion formula is as follows: $C/N_0 = 27 + 20\log_{10}(\text{SNR}[\text{AMUs}])$
Last Updated	The system time when the GPS receiver last updated the information for a specific satellite (for more information, see Table 7-1 "Taurus time definitions" on page 65).

G.5.3 GPS Map

Table G-7 GPS map page overview

	Description
PDOP	Position Dilution of Precision A standard estimate of the GPS position precision based on the geometry of the visible satellites. A lower value indicates a more precise position calculation. The GPS receiver will not generate a position calculation if the PDOP is too high.
TDOP	Time Dilution of Precision A standard estimate of the GPS time precision based on the geometry of the visible satellites. A lower value indicates a more precise position calculation.
GPS satellite sky plot	The sky plot shows the positions of the GPS satellites, labelled with Pseudo-Random Noise codes, and a graph of the received signal strength of each satellite in antenna measurement units.
Update Time	The system time when the GPS receiver last updated the information (for more information, see Table 7-1 "Taurus time definitions" on page 65).
GPS State	The tracking status of the GPS receiver
Location	The current latitude, longitude, and elevation of the Taurus

G.6 Store Tools

The Store Tools page shows information about the active recording medium (IDE drive or Compact Flash card) and the availability of other media. If you are logged in, you can also view media and Store management options. For more information, see [Chapter 9 "Recording Data."](#)

Table G-8 Store tools page overview

	Description
Active Media	The active media type, either IDE (IDE hard drive) or CF (CompactFlash card)
Store Size	The capacity of the active Store This is configured when the Store is created. For more information, see Section 9.1.2 "Deleting and Recreating Stores" on page 83.
Compact Flash/IDE Available	Indicates if an ext3-formatted recording medium is available in the other slot
Switch Media	Switches the media used for recording data. For more information, see Section 9.2.3 "Switching Recording to the Other Medium" on page 88.
Format Compact Flash/IDE	Formats the active media. For more information, see Section 9.2.2 "Formatting Recording Media" on page 86.
Reindex Store	Reindexes the Store. For more information, see Section 9.1.3 "Reindexing Stores" on page 83.
Delete Store	Deletes the Store. For more information, see Section 9.1.2 "Deleting and Recreating Stores" on page 83.



You can click the help button  to view information about the options on the Store Tools page.

G.7 System Info

The System Info pages show the firmware and hardware version information for the Taurus.

- ◆ Firmware page – Shows the version of the Taurus firmware that is installed and the version information for each of the firmware components.

If you are using a Web browser to view this page, you can also download the firmware and hardware information as a text file (see [Section 10.7 "Downloading Taurus System Information"](#) on page 99).

- ◆ Hardware page – Shows the serial number (where applicable) and version information for each of the Taurus subcomponents.



If you have a Trident 305 connected to the Taurus, you can view system information for that Trident by selecting the arrow  in the upper-right corner of the System Info page and selecting the Trident 305 from the list.

Appendix H

Configuration UI Pages

H.1 Configuration Pages

To change the configuration settings of a Taurus, you have to be logged in with one of the following user accounts: tech or central. For more information, see [Table 2-1 "User roles and permissions"](#) on page 23.



For more information on making configuration changes, see [Section 5.1 "Making Configuration Changes"](#) on page 49 and for tips see [Section 5.1.1 "Configuration Pages Tips"](#) on page 50.

H.2 General

Table H-1 General settings

Setting	Description
Taurus Running Mode	The operating mode of the Taurus For more information, see Section 2.4 "Selecting the Taurus Running Mode" on page 27
SOH Report Interval [s]	The SOH sampling rate in seconds, including some internal SOH and the four External SOH channels Enter an integer from 5 to 3600. The default setting is 60.
UI Timeout [min]	The time delay in minutes before the Taurus shuts down the display screen and and reverts to the configured running mode. The default setting is 10. Note: This setting is overridden by UI activity and data downloads as described in Section 2.5 "Setting the UI Timeout" on page 28.
UI Auto Refresh	Select this option to allow the UI to refresh automatically. By default, this option is selected.
Apollo Log Verbosity	The level of detail of the Apollo log: <ul style="list-style-type: none">◆ Info – All errors, warnings, and minimal system status information◆ Verbose – All error, warnings, and more detailed system status information◆ Debug – All errors, warnings, and extensive system status information The default setting is Info. Note: You should only select Debug as the logging level if you were instructed to do so by Nanometrics Technical Support.

Table H-1 General settings (Continued)

Setting	Description
ARM Log Verbosity	<p>The level of detail of the ARM log:</p> <ul style="list-style-type: none"> ♦ Info – All errors, warnings, and minimal system status information ♦ Verbose – All error, warnings, and more detailed system status information ♦ Debug – All errors, warnings, and extensive system status information <p>The default setting is Info.</p> <p>Note: You should only select Debug as the logging level if you were instructed to do so by Nanometrics Technical Support.</p>
GPS Duty Cycle Mode	<p>The GPS receiver duty cycle</p> <ul style="list-style-type: none"> ♦ Always On – Always On will use approximately an additional 200mW but will provide the most accurate timing. Since GPS time is always available, System Time can always be kept close to UTC such that the time error of the Taurus is typically not more than a few microseconds. ♦ Automatic – Automatic is the most efficient setting for Taurus power consumption. The duty cycling strategy is that the GPS receiver is switched on until fine lock is reached in the system clock then switched off until the estimated time uncertainty reaches a predefined limit such that the expected time error is still less than the 100μs specification. The uncertainty estimate is based on clock drift and temperature measurements. ♦ Every 10 minutes Every 30 minutes – You can use a constant duty cycle, either every 10 minutes or every 30 minutes. You should verify that the time error does not exceed your requirements when the GPS receiver is switched back on after these time intervals. Use the GPS Time SOH file to inspect the time error. <p>The default setting is Automatic.</p>
Minimum Tridents	<p>The minimum number of Tridents that the Taurus expects to detect.</p> <p>Note: If the number of detected Tridents is less than this value, both the Tridents status bar on the Status Details page and the SuperLED are red.</p>

H.3 Communications

For more information, see [Section 6.2 “Communications over Ethernet”](#) on page 54 and [Section 6.3 “Communications over Serial Ports”](#) on page 55.

Table H-2 Communications settings

Setting	Description
Default interface	<p>The interface where the routing gateway is located (Ethernet or Serial Port 1).</p> <p>All packets not on an immediate subnet (more than a single hop) will be sent to a gateway determined by that interface.</p> <p>The gateway is configured as an IP address of a computer. The Taurus can have multiple gateways configured and the default interface specifies which gateway is in effect. Only one gateway is allowed.</p> <ul style="list-style-type: none"> ♦ Ethernet – The gateway used is the one obtained from the settings specified on the Ethernet settings page. ♦ Serial Port 1 – The gateway used is the remote IP address configured on the Serial Port 1 page. The serial port must be in either SLIP or PPP mode for this setting.

H.3.1 Serial Port 1

For more information, see [Section 6.3 "Communications over Serial Ports"](#) on page 55.

Table H-3 Serial port 1 settings

Setting	Description
Mode	The serial port protocol For more information, see Table 6-1 "Serial port protocols" on page 55.
Speed [bps]	The transmission rate between the Taurus and a connected serial device The default setting is 9600.
Local IP	The IP address of the local Taurus interface for SLIP/PPP connections
Remote IP	The IP address of the remote interface for SLIP/PPP connections

H.3.1.1 SLIP

Table H-4 SLIP settings

Setting	Description
Protocol	The type of SLIP protocol: standard (SLIP) or compressed (CSLIP) The default setting is SLIP.

H.3.1.2 TDMA

Table H-5 TDMA settings

Setting	Description
Enable TDMA	Select this option to allow the Taurus to use TDMA. When this option is selected, the Taurus only sends data to Serial Port 1 during the defined time slot. When this option is not selected, data is sent immediately when the line is idle. By default, this option is not selected.
Frame Length [ms]	The TDMA frame length in milliseconds The frame length must be set to the same value for the devices sharing the link. Enter an integer from 1000 to 10000. The default setting is 4000.
Slot Start [%]	The Taurus TDMA slot start position as a percentage of the entire frame Enter an integer from 0 to 99. The default setting is 0. Note: The slot start plus slot duration must be less than or equal to 100.
Slot Duration [%]	The Taurus TDMA slot duration as a percentage of the entire frame Enter an integer from 1 to 99. The default setting is 80. Notes: <ul style="list-style-type: none"> ♦ The slot start plus slot duration must be less than or equal to 100. ♦ The minimum slot size is determined by the largest frame that can be transmitted over the serial link (Section 6.3.5 "Configuring a PPP Connection" on page 61).

H.3.2 Discovery

For more information, see [Section 6.5 "Discovery"](#) on page 64.

Table H-6 Discovery settings

Setting	Description
Enable Discovery	Select this option to allow the Taurus to send out identification messages to other devices on the network. By default, this option is selected.
IP Address	A valid multicast IP address The first octet must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255. The default setting is 224.199.71.138.
Port #	The port number used by the Taurus for discovery broadcasts. The default setting is 6776.

H.3.3 Ethernet

For more information, see [Section 6.2 "Communications over Ethernet"](#) on page 54.

Table H-7 Ethernet settings

Setting	Description
Ethernet Mode	The method the Taurus uses to acquire an IP address. The default setting is DHCP.
Ethernet Static IP Address	The IP address assigned to the Taurus This setting is only applicable if the Ethernet mode is set to Static IP. The default setting is 127.0.0.1.
Ethernet Static Subnet Mask	The network mask for the Taurus static IP address This setting is only applicable if the Ethernet mode is set to Static IP. The default setting is 255.255.0.0.
Static Default Gateway	The default gateway address for the static IP address This setting is only applicable if the Ethernet mode is set to Static IP.

H.4 Data Streaming

For more information, see [Chapter 11 "Streaming Data."](#)

H.4.1 NP Streaming

Select **NP Streaming** on the Configuration > Data Streaming page and then select the name of a NP Streamer to view the following settings:

Table H-8 NP streamer settings

Setting	Description
Name	The name of the NP streamer This name appears on the NP Streaming page and you can select the name to edit the settings of the streamer.
Enable Streaming	Select this check box to enable the NP streamer to stream data. By default, this check box is not selected.
Stream Time Series	Select this check box to stream time series data.
Stream NAQS SOH	Select this check box to stream SOH data to a NAQSServer. Note: To stream data in a NP format to a NAQSServer, the NpToNmxp utility must be running on the NAQSServer. For more information, see the NpToNmxp User Guide.
Stream All SOH	Select this option to stream all SOH data.
IP Address	The valid IP address of the streaming destination in dotted decimal format -OR- A valid multicast IP address The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255.
Port #	The port number used by Taurus to stream data in the NP format. The default port is 32004.
Multicast TTL	If the streaming destination address is multicast, you can increase the Time-To-Live (TTL) of the packets by specifying the number of networks (routers) that the packet must cross to reach the destination. For example, if the packets have to cross five networks to reach the destination, you should set the Multicast TTL to 5. Caution: All of the routers must support the Time-To-Live feature. In some cases, this feature might be disabled for security reasons (Denial-of-Service attack).
ReTx Strategy	<ul style="list-style-type: none"> ♦ First-Come, First-Served – ReTx Requests are processed in the order received. Incoming messages that are the same as or part of an existing request are merged and processed in the order of the original request. ♦ Ordered, with Short Term Complete – ReTx Requests are processed in data request time order (oldest first), except for requests with data in the recent past (within the Short Term Complete Threshold). This option is useful if you are using NAQSServer in Short Term Complete mode.

Table H-8 NP streamer settings

Setting	Description
Short Term Complete Threshold [min]	<p>The time in minutes in which recent requests should be processed before oldest requests are processed.</p> <p>The default setting is 5 minutes.</p> <p>Note: You only have to configure this setting if you selected Ordered, with Short Term Complete as the ReTX Strategy.</p>

H.4.1.1 Throttle

Table H-9 Throttle settings (NP streamer)

Setting	Description
Enable throttle	Select this option to set the maximum data output of the NP streamer (for example, because of a low-throughput link).
Maximum throughput [bps]	The maximum throughput in bits per second

H.4.1.2 Fragmentation

Table H-10 Fragmentation settings

Setting	Description
Enable Fragmenting	Select this option to set the maximum packet size for routers that do not allow IP fragmentation.
Fragment Size [B]	The maximum fragment size in bits
Include CRC	Select this option if you want a cyclic redundancy check performed on each fragment to verify that the data is not corrupted.

H.4.2 WIN Streaming

Table H-11 WIN streamer settings

Setting	Description
Stream WIN Packets	Select this option to stream data in the WIN format. By default, this check box is not selected.
UTC Offset [h]	The amount of time in hours that the time zone used in the WIN packets is offset from Coordinated Universal Time (UTC). The default setting is 9.
IP Address	The valid IP address of the streaming destination in dotted decimal format -OR- A valid multicast IP address The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255.
Port Number	The port number used by Taurus to stream data in the WIN format. The default port is 32004.
Max. Packet Bytes [B]	The maximum number of bytes in each packet The default setting is 1500.
Enable 1	Select this option if you want Taurus Channel 1 enabled to stream data in the WIN format.
Taurus Channel 1	Enter a unique decimal or hexadecimal channel number for Taurus Channel 1. -OR- Accept the default channel number.
Enable 2	Select this option if you want Taurus Channel 2 enabled to stream data in the WIN format.
Taurus Channel 2	Enter a unique decimal or hexadecimal channel number for Taurus Channel 2. -OR- Accept the default channel number.
Enable 3	Select this option if you want Taurus Channel 3 enabled to stream data in the WIN format.
Taurus Channel 3	Enter a unique decimal or hexadecimal channel number for Taurus Channel 3. -OR- Accept the default channel number.
Enable 1	Select this option if you want Trident Channel 1 enabled to stream data in the WIN format.
Trident Channel 1	Enter a unique decimal or hexadecimal channel number for Trident Channel 1. -OR- Accept the default channel number.
Enable 2	Select this option if you want Trident Channel 2 enabled to stream data in the WIN format.
Trident Channel 2	Enter a unique decimal or hexadecimal channel number for Trident Channel 2. -OR- Accept the default channel number.
Enable 3	Select this option if you want Trident Channel 3 enabled to stream data in the WIN format.

Table H-11 WIN streamer settings

Setting	Description
Trident Channel 3	Enter a unique decimal or hexadecimal channel number for Trident Channel 3. -OR- Accept the default channel number.

H.4.2.1 Throttle

Table H-12 Throttle settings (WIN streamer)

Setting	Description
Enable throttle	Select this option to set the maximum data output of the WIN streamer (for example, because of a low-throughput link).
Maximum throughput [bps]	The maximum throughput in bits per second

H.5 Security

You can only access the Security page if you are logged in with the `central` user account. For more information, see [Section 2.3.1 "Logging In"](#) on page 24.

Table H-13 Security settings

Setting	Description
Local Authentication	The type of authentication used for logging in with the Taurus display screen. For more information, see Section 2.3.1.2 "Quick Log In Using the Display Screen" on page 25.
Quick Login User ID	The account that is used for Quick Login. This setting is only applicable if Quick Login is selected as the Local Authentication type. The default setting is <code>user</code> .

H.6 Data Retrieval

For more information, see [Chapter 10 "Viewing and Retrieving Data."](#)

Table H-14 Data retrieval settings

Setting	Description
Network Name	The network name or code Enter a two-digit alphanumeric value.
Station Name	The station name for this Taurus Enter a five-digit alphanumeric value (for example, T0105 for Taurus serial number 0105). Note: If you specify a station name other than the default name (STN01), it is displayed in the upper-right corner of the page next to the Taurus serial number (ID). Example: A0737 ID: 737

Table H-14 Data retrieval settings

Setting	Description
Location Name	The location name for this Taurus
Channel # Name	The channel name for each of the time series data channels Enter a three-digit alphanumeric value (for example, BHZ, BHN, or BHE).
Retrieval Mark	The date and time the last data was retrieved by Apollo Project for a Field Archive project. Apollo Project automatically Stores this date in the Taurus after it retrieves data for a Field Archive project and uses it as the starting point for a future data download. The Retrieval Mark box is blank if Apollo Project has not been used to download data from a Taurus for a Field Archive project. You can delete the date if you want Apollo Project to download all of the data from the start of the project the next time you run a Field Archive project. You can also change the date if you only want data downloaded from a specific point in time. Note: This setting is only used by Apollo Project for Field Archive projects. If you do not use Apollo Project or Field Archive projects, you can ignore this setting. For more information on Apollo Project data retrieval and Field Archive projects, see the Apollo Project User Guide.

H.7 Calibration

For more information, see [Section 8.4 "Configuring Sensor Calibration"](#) on page 76.

Table H-15 Calibration settings

Setting	Description
Calibration Name	The name of the calibration This name appears in the configuration change history file that you can download. For more information, see Section 5.4 "Viewing Configuration Change History" on page 52.
Calibration Type	The type of calibration signal generated by the Taurus: Sine, Pulse, or PRB. The default setting is Sine.
Attenuation	The value used to attenuate the calibration signal. You can use attenuation to select the range when lower amplitude signals are desired. A more accurate 5mV signal is generated when using attenuation of 1000 and amplitude 5V rather than attenuation of 1 and amplitude 0.005V. The default setting is 1.
Amplitude	The amplitude of the calibration signal in volts or amperes The units depend on the configured Calibration Mode (Voltage or Current). You can enter a value up to 5.0V or 60mA. If taken as a single-ended output (for example, between pin N (SEN_CAL1+) and pin V (DGND)), the calibration circuit can provide a signal with a maximum amplitude of 4.5V. The default setting is 0.1. Notes: <ul style="list-style-type: none"> ♦ Ensure that you choose a value low enough that the signal will not clip. If you have configured the calibration mode as Voltage, ensure that you know the calibration coil resistance. ♦ See step 4 of Section 8.3.3 "Editing Custom Sensor Configurations" on page 73 for information on how to configure the calibration mode.

Table H-15 Calibration settings

Setting	Description
Wait Time [s]	The length of time in seconds that the Taurus waits after the calibration coil has been enabled before it sends the calibration signal. The default setting is 0.
Ramp Duration [s]	The length of time in seconds the Taurus uses to bring the signal amplitude up to the configured amplitude and down from the configured amplitude. The default setting is 0. Note: The ramp duration is usually set to 0 for pulse and PRB signals.
Duration [s]	The length of time in seconds during which the Taurus applies the calibration signal to the sensor at the configured amplitude. The default setting is 60.
Sine Frequency [Hz]	The sine signal frequency in hertz Enter a number between 0.01000 and 50.0000. The default setting is 1.0. Note: This setting is ignored for pulse and PRB signals.
Pulse Duration [ms]	The pulse signal segment width in milliseconds The default setting is 1000. Note: This setting is ignored for sine and PRB signals.
PRB Pulse Width [ms]	The PRB (Pseudo-Random Binary) signal unit pulse width in milliseconds The default setting is 1000. Note: This setting is ignored for pulse and sine signals.
Enable Channel 1	Select this option if you want channel 1 enabled for calibration.
Enable Channel 2	Select this option if you want channel 2 enabled for calibration.
Enable Channel 3	Select this option if you want channel 3 enabled for calibration.

H.8 Digitizer

For more information, see [Chapter 7 “Configuring the Digitizer.”](#)

H.8.1 Main

Table H-16 Main settings

Setting	Description
Sample Rate [Hz]	<p>The sample rate in hertz (samples per second) on the sensor signal</p> <p>The default setting is 100.</p> <p>Notes:</p> <p>The valid value ranges for some of the trigger parameters depend on the sample rate, therefore some sample rates might be incompatible with your current trigger settings.</p> <p>500 sps is not supported in Buffered mode.</p>
Output Channels	<p>The Digitizer has three time series data channels that are constantly digitizing data. The data from each of these channels is recorded by the Controller and written to the Store.</p>
Enable DC Removal	<p>The DC removal filter is a high pass filter with a configurable low corner frequency.</p> <p>Select this option if you want this filter used on data. By default, this option is not selected.</p>
DC Removal Cutoff [Hz]	<p>The DC Removal cutoff refers to the corner frequency of the high pass filter in hertz (the DC Removal filter). All signal frequencies below this are removed.</p> <p>Enter a number between 0.001 and 1.0. The default setting is 0.001.</p>
Frames Per Packet	<p>The number of standard Steim data frames per packet for transmission of time series data.</p> <p>The default setting is 7.</p> <p>Note: If you plan to extract data in the MiniSEED or MiniSEED sorted format, you should set this value to 3 or 7.</p>

H.8.2 Timing

For more information, see [Section 7.1.1 "Taurus Times"](#) on page 65 and [Section 7.1.2 "System Clock Correction"](#) on page 66.

Table H-17 Timing settings

Setting	Description
Resynchronization Mode	<p>Defines how the Taurus makes a time error correction:</p> <ul style="list-style-type: none"> ◆ Discard Samples - A time correction is performed in a multiple of 100μs when the time error between the Taurus and GPS time exceeds 66.7μs. To preserve data quality, the FIR filters buffers are flushed of their samples and the FIR filtering is disabled for a few hardware samples, so that the first output sample occurs on a UTC aligned multiple of the output sample period. ◆ Slow Coarse Lock - A time correction is performed in a multiple of the output sample period when the time error between the Taurus and GPS time is greater than 2/3 the output sample period. For example, for 100 samples per second, the time correction is performed in multiples of 10ms when the time error exceeds 6.67ms. Before digitizing has started, the time corrections are performed in multiples of 100μs to minimize the time error. ◆ No Alignment - A time correction is performed in a multiple of 100μs when the time error between the Taurus and the GPS disciplined clock exceeds 66.7μs. When first starting to digitize, after power-on or after a reboot, the output samples are UTC aligned. The Taurus can be rebooting via the user interface to restore the output samples to UTC alignment. <p>The default resynchronization mode is Discard Samples.</p>
Require Good Time	<p>Select this option if you want good time quality (that is, GPS lock) to be required before the Taurus starts digitizing data.</p> <p>By default, this option is not selected.</p>
Use HRD Alignment	<p>Determines if after a time error correction the next sample will have an alignment based on the algorithm used in the HRD (a previous-generation Nanometrics digitizer).</p> <p>You can use this option if you have Nanometrics HRDs in your network, so output samples from both Taurus and HRD instruments are synchronized in the same way.</p> <p>By default, this option is not selected.</p>

H.8.3 Front End

Table H-18 Front end settings

Setting	Description
Input Range, diff p-to-p [V]	<p>The input voltage ranges represent the differential between the sensor positive and negative signal inputs, in volts peak-to-peak. The maximum input range is 40 volts peak-to-peak. This represents the case of a differential input signal that at one peak has +10V on the positive input and -10 V on the negative input (20 V peak). At the other peak, the differential input is -20 V, for a peak-to-peak input range of 40 V.</p> <ul style="list-style-type: none"> If you want to accurately measure full-scale sensor activity, the input range of the sensor must be greater than the maximum output level of the sensor. However, if the sensor has a very large dynamic range and the Input Range is set to a large value (to capture full-scale movement), accuracy will be lost when measuring very weak seismic signals. If you want to accurately measure very weak seismic signals, the input range of the sensor must be set to a small enough value to accurately digitize weak signals. If strong seismic events occur that exceed the configured range, these signals will be clipped. Increased sensitivity (lower input ranges) also tend to increase overall data volume. For example, a 3-channel 100 sps configuration might generate 3000 bps of sampled data. If the same system is reconfigured with much greater sensitivity, the increased signal activity might cause the average data throughput to rise to 6000 bps or more. <p>The default setting is 40.</p> <p>Note: An input range of 40V_{pp} is not supported when both high input impedance and normal common mode range are selected.</p>
Input Impedance	<p>Low input impedance mode (43.07kΩ) has the best immunity to noise pickup and is the preferred mode when using active sensors. High input impedance mode (>9MΩ) is provided for use with some passive sensors that require a damping load shunt resistor which is higher than the Taurus low input impedance. If the required load resistor is lower than the Taurus input impedance, you can use the Taurus in low impedance mode by choosing a shunt resistor that, in parallel with the Taurus input impedance, achieves the desired load shunt value. Alternatively, you can put the Taurus in high input impedance mode to use the load shunt resistor value specified by the passive sensor directly.</p> <p>In low input impedance mode, the Taurus input impedance forms a voltage divider with the output impedance of the source signal so that a 436Ω source, for example, would result in a 1% decrease in signal amplitude at the Digitizer. The exact signal amplitude is as follows:</p> $\text{Taurus Input} = R_i / (R_s + R_i) \cdot \text{Sensor Output}$ <p>where R_i is the Taurus input impedance and R_s is the total source impedance (both sides of the differential source output plus both conductors of the sensor-to-digitizer cable).</p> <p>The voltage divider effect is negligible when using high input impedance mode, where attenuation is less than 0.1% for source impedance up to 9kΩ.</p> <p>The default setting is Low.</p> <p>Note: High input impedance is not supported when both normal common mode range and an input range of 40V_{pp} are selected.</p>

Table H-18 Front end settings

Setting	Description
Common Mode Range	<p>In normal common mode, the rejection range is ± 0.78 V and the clip level for ground-referenced single-ended signals is ± 1.56 V.</p> <p>In extended common mode, the rejection range is ± 1.8 V and the clip level for ground-referenced single-ended signals is ± 3.6 V. This is provided for use with sensors that have single-ended outputs referenced to ground or where unusually high common mode signals must be rejected. This mode consumes approximately 40 mW of additional power.</p> <p>The default setting is Normal.</p> <p>Note: Normal common mode range is not supported when both high input impedance and an input range of $40V_{pp}$ are selected.</p>
Enable Dither	<p>The Enable Dither option adds a very small random signal to the input signal of the Digitizer at an amplitude low enough that the dynamic range of the Digitizer is not reduced. This is done to virtually eliminate so-called idle tones.</p> <p>Idle tones are a phenomenon that might occur only when the input is held to zero (or pure DC) so that the least significant bit of the Digitizer output can flip around in a quasi-periodic pattern. Idle tones seen on Taurus when dither is turned off have virtually no energy, are not indicative of a malfunction, and are not present when recording real data.</p> <p>Selecting the Enable Dither option costs an approximate 10mW power. By default, this option is not selected.</p>
Software Gain	<p>You can set the Digitizer gain to attenuate or amplify the sensor input signal to a level that will optimize the use of the Digitizer dynamic range. After the Taurus digitizes the signal, it multiplies the amplitude by the software gain value. The default setting is 1.0 (that is, no change in amplitude).</p> <p>This setting can be used to adjust the sensitivity of a station to match a desired value. For example, if a specific site has a sensitivity of $0.8 \text{ cnt}/(\text{nm}/\text{s}/\text{s})$ and you want all stations in the network to have a sensitivity of $1 \text{ cnt}/(\text{nm}/\text{s}/\text{s})$ you can set the Software Gain in this station to 1.25. You can normalize the sensitivity of each station by adjusting the Software Gain or you can choose to create a different baseband response file (a seed.rsp file) for each station and use this file during data analysis at the central site.</p> <p>Enter a number between 0.001 and 100.</p>
Enable Hard Clip	<p>A sigma-delta convertor output can transition sharply overscale if the input signal is near or exceeds the full scale input range, creating spikes in the output (that can also transition down into the range). The Enable Hard Clip option cuts off the spikes that exceed the expected full scale limit by replacing samples that are over-scale with the specified limit. The effect of the Digitizer output spiking at full scale might still be evident even with hard clipping on as these spikes can also transition down within the normal operating range of the Digitizer even though the input is at or above full scale.</p> <p>By default, this option is not selected.</p>

H.8.4 Triggers

Select the check boxes to enable channels on the main Triggers page and configure the following input filter and detector settings on the Input Filter and Detector pages.



Trigger information can also be extracted to a .csv file (for more information, see [Section 10.5 "Extracting System Logs"](#) on page 98).

H.8.4.1 Input Filter

The input filter configured on this page is used for all detectors.

Table H-19 Input filter settings

Setting	Description
High Pass Order	The order of the high pass filter Select a number from 0 to 5. The default setting is 0.
High Pass Frequency [Hz]	The 3dB corner frequency in hertz of the high pass filter Enter a decimal number where $0.000001 < \frac{f}{sampleRate} < 0.499999$. The default setting is 0.001.
Low Pass Order	The order of the low pass filter Select a number from 0 to 5. The default setting is 0.
Low Pass Frequency [Hz]	The 3dB corner frequency of the low pass filter Enter a decimal number where $0.000001 < \frac{f}{sampleRate} < 0.499999$. The default setting is 1.0.

H.8.4.2 Detectors

You can configure a detector for each of the enabled channels:

- Detector 1 = Channel 1
- Detector 2 = Channel 2
- Detector 3 = Channel 3

Table H-20 Detector settings

Setting	Description
STA Time Constant n [s]	The short term time constant (TC) in seconds Choose a value longer than a few periods of a typical expected seismic signal of interest, shorter than expected durations of events of interest, and not so short that excessive false triggers are generated by non-seismic noise spikes near the site.) Enter a decimal number where $0.000001 < \frac{\left(\frac{1}{2\pi \cdot TC}\right)}{sampleRate} < 0.499999$. The default setting is 1.
LTA Time Constant n [s]	The long term average time constant (TC) in seconds Choose a value long enough to encompass at least several cycles of typical non-seismic, irregular noise for the site. Enter a decimal number where $0.000001 < \frac{\left(\frac{1}{2\pi \cdot TC}\right)}{sampleRate} < 0.499999$. The default setting is 5.
Trigger On Ratio n	The STA/LTA threshold above which the associated channel is triggered. Choose a value low enough to be sensitive to events of interest but high enough to minimize false triggers. Enter a decimal number where $0 < Trigger\ Off\ ratio < Trigger\ On\ ratio$. The default setting is 5.

Table H-20 Detector settings

Setting	Description
Trigger Off Ratio <i>n</i>	<p>The STA/LTA threshold below which the associated channel trigger is switched off.</p> <p>Choose a value low enough to encompass the coda waves for events of interest but high enough to terminate the trigger reasonably. The trigger terminates either when the Trigger Off Ratio is achieved or when the Maximum Duration has expired.</p> <p>Enter a decimal number where $0 < \text{Trigger Off ratio} < \text{Trigger On ratio}$. The default setting is 1.</p>
Maximum Duration <i>n</i> [s]	<p>The maximum duration in seconds of a trigger</p> <p>After this time period has expired, the trigger is ended even if the Trigger Off Ratio has not been achieved.</p> <p>Enter a decimal number from 0.001 to 3600. The default setting is 3600.</p>
Latch LTA <i>n</i>	<p>If you select this option, the LTA is held at the value when the channel triggered and is not updated while the channel is triggered.</p> <p>If you do not select this option, the LTA continues to be calculated and updated while the channel is triggered.</p> <p>In both cases, the trigger terminates either when the Trigger Off Ratio is achieved or when the Maximum Duration has expired.</p> <p>By default, this option is not selected.</p>

H.9 Power Manager

For more information, see [Section 4.4 "Configuring Power Manager Settings"](#) on page 46.



The default power manager settings are for 12V lead-acid batteries. To protect your equipment, confirm the appropriate values for your power system and the maximum voltage tolerance of your sensor before configuring these settings.

Table H-21 Power supply settings

Setting	Description and Permitted Values
Low Voltage Turn Off [mV]	<p>When the external power supply voltage falls below the Low Voltage Turn Off threshold and remains below this threshold for the Delay Low period, the Taurus powers off immediately.</p> <p>You can specify an integer from 9000 to 36000. The factory default setting is 10500.</p> <p>Notes:</p> <p>Set the turn off value so as to properly protect the battery for your power supply. Voltage drops in long power supply cables should also be considered in determining these values.</p> <p>If the supply voltage is lower than the configured Low Voltage Turn Off value, the Taurus will not power up. You can bypass these voltage threshold settings on power up, see Section 4.3.2.1 "Bypassing the Power Supply Threshold Settings on Start-Up" on page 46.</p>

Table H-21 Power supply settings (Continued)

Setting	Description and Permitted Values
Low Voltage Turn On [mV]	<p>When the external supply voltage rises above the Low Voltage Turn On threshold, the Taurus powers up but not before 10 seconds has elapsed since the last shut down.</p> <p>You can specify an integer within the range of High Voltage Turn Off and Low Voltage Turn Off. The factory default setting is 11800.</p> <p>Note: Set the turn on value high enough to prevent the unit from prematurely turning on due to battery rebound. Voltage drops in long power supply cables should also be considered in determining these values.</p>
High Voltage Turn On [mV]	<p>When the external power supply voltage drops below the High Voltage Turn On threshold, the Taurus powers up but not before 10 seconds has elapsed since the last shut down.</p> <p>You can specify any integer within the range of High Voltage Turn Off and Low Voltage Turn Off. The factory default setting is 35000.</p> <p>Note: If the supply voltage is higher than the High Voltage Turn On value, the Taurus will not power up. You can bypass these voltage threshold settings on power up, see Section 4.3.2.1 "Bypassing the Power Supply Threshold Settings on Start-Up" on page 46.</p>
High Voltage Turn Off [mV]	<p>When the external power supply voltage rises above the High Voltage Turn Off threshold and remains above this threshold for the Delay High period, the Taurus powers off immediately.</p> <p>You can specify an integer from 9000 to 36000. The factory default setting is 36000.</p>
Delay Low [ms]	<p>When the external power supply voltage falls below the Low Voltage Turn Off threshold and remains below this threshold for the Delay Low period, the Taurus powers off immediately.</p> <p>You can specify an integer from 0 to 300. The factory default setting is 30.</p>
Delay High [ms]	<p>When the external power supply voltage rises above the High Voltage Turn Off threshold and remains above this threshold for the Delay High period, the Taurus powers off immediately.</p> <p>You can specify an integer from 0 to 300. The factory default setting is 2.</p>

H.10 Sensor Library

The Taurus ships with default sensor configurations that you can use as the configuration for your sensors. These default sensor configurations are listed on the Sensor Library page. Any new sensor configurations that you create are also listed on the Sensor Library page.

You can create new sensor configurations on the Sensor Library page and you can also copy or edit existing ones. A sensor configuration contains the mode, power, voltage, sensitivity, control line, and calibration settings for a sensor. For more information, see [Section 8.3 "Configuring Sensors"](#) on page 71.

Select the name of a sensor configuration on the Configuration > Sensor Library page to view the following settings:

Table H-22 Sensor configuration settings

Setting	Description
Sensor Name	The name of the sensor configuration This is the name that appears on the Sensor Library page.
SP/LP Mode	The operating mode of the sensor: short period (SP) or long period (LP)
XYZ/UVW Mode	The orientation of the sensor elements: XYZ or UVW UVW indicates a triaxial seismometer. If you select UVW mode, the calibration will run separately on each channel.
Calibration Mode	The calibration signal mode: Voltage or Current Refer to your sensor manual for information on which signal mode you should choose.
Needs Power	Select this option if the sensor needs power (active sensors). Do not select it for passive sensors that never require power.
Sensitivity Units	Refer to your sensor manual for the appropriate value: V/(m/s) or V/(m/s/s).

H.10.1 Sensor Control Lines



The default values are for a Trillium 40 seismometer. Refer to your sensor manual for the appropriate values for your seismometer.

Table H-23 Sensor control line settings

Setting	Default Setting
Assert (On) Level	The assert line level
Deassert (Off) Level	The deassert line level
Positive Voltage Level	+5V Note: The tolerance of these voltage levels is +/-10%.
Pulse Duration [s]	The control pulse duration in seconds
Control Line 1 (pin H)	XYZ/UVW On=UVW
Control Line 2 (pin W)	SP/LP On=SP
Control Line 3 (pin G)	Unused Deassert
Control Line 4 (pin Z)	Ch 1 Cal Enable Note: If you selected Current as the Calibration Mode (see Section 8.3.3 "Editing Custom Sensor Configurations" on page 73, this control line will not be available for any other configuration option. It will be reserved for calibration current return.
Control Line 5 (pin c)	Ch 2 Cal Enable Note: See note for Control line 4 (pin Z).
Control Line 6 (pin Y)	Ch 3 Cal Enable Note: See note for Control line 4 (pin Z).

H.10.2 Auto Mass Centring

You can configure the Auto Mass Centring options to initiate mass centring attempts when sensor mass positions reach off-centre thresholds. You can set thresholds for a delayed or an immediate recentring attempt (yellow and red thresholds respectively) and set the number of retries and retry intervals to achieve centred masses. You must have a control line configured for Mass Centre and have at least one of the following thresholds enabled:

- ♦ Auto Centre on Yellow – The Taurus will initiate mass centring when any axis has been above the Yellow Threshold for more than the Yellow Holdoff Time. If all axes drop below the Yellow threshold during holdoff time, then the holdoff time is cancelled.
- ♦ Auto Centre on Red – The Taurus will initiate mass centring 1 minute after any axis exceeds the Red Threshold.

Each mass centring attempt is comprised of the configured number of retries at the configured retry interval. Retries will be attempted until all axes are below the yellow threshold or until the number of retries per Auto Centre have been executed.



You can only configure Auto Mass Centring options for the following Nanometrics seismometers: Trillium 120PA and Trillium 240.

The Sensor page shows the status of the mass position (see [Section 8.1 “Monitoring Sensor Operation”](#) on page 69).

Table H-24 Mass auto-centring settings

Setting	Description
Red Threshold [V]	<p>The minimum voltage level used to indicate that the mass position is out of range.</p> <p>Mass centring is initiated one minute after this level is crossed for any sensing element. The threshold range is from negative to positive, for example 1 indicates -1 to +1.</p> <p>Enter a number that is equal to or higher than 0.001 and greater than the yellow threshold (if used).</p> <p>The default setting is 1.000000.</p> <p>Note: If you use both the red and the yellow thresholds, ensure that you set the yellow threshold as the lower mass position limit and the red threshold as the higher mass position limit (red >= yellow).</p>
Auto-Centre on Red	<p>Select this option if you want the Taurus to initiate mass centring when the Red Threshold is crossed.</p> <p>By default, this option is not selected.</p>
Yellow Threshold [V]	<p>The minimum voltage level used to indicate that the mass position is marginal.</p> <p>Mass centring is initiated after the Yellow Holdoff Time has expired. The threshold range is from negative to positive: for example, 1 indicates -1 to +1.</p> <p>Enter a number that is equal to or higher than 0.001 and lower than the red threshold (if used).</p> <p>The default setting is 1.000000.</p>
Auto-Centre on Yellow	<p>Select this option if you want the Taurus to initiate mass centring when the Yellow Holdoff Time expires.</p> <p>By default, this option is not selected.</p>
Yellow Holdoff Time [h]	<p>The number of hours the Taurus waits when any mass position voltage is higher than the yellow threshold but lower than the red threshold before initiating mass centring.</p> <p>Enter a number between 0.1 and 72.</p>
Retries per Auto-Centre	<p>The maximum number of attempts the Taurus makes to centre the masses.</p> <p>Enter an integer between 0 and 20.</p> <p>The default setting is 10.</p>
Retry Interval [min]	<p>The number of minutes the Taurus waits between trying to automatically centre the masses again.</p> <p>Enter an integer between 1 and 20.</p> <p>The default setting is 10.</p>

Appendix I

Glossary

I.1 Glossary of Abbreviations and Terms

A

AC

Alternating Current

ADC

Analog to Digital Converter

AGND

Analog Ground

AMU

Antenna Measurement Unit

ASCII

American Standard Code for Information Interchange

ATA

Advanced Technology Attachment

AWG

American Wire Gauge

C

CF

CompactFlash

CD

Carrier Detect

CHGND

Chassis Ground

CRC

Cyclic Redundancy Check

CTS

Clear to Send

D

DAC

Digital to Analog Converter

DC

Direct Current

DGND

Digital Ground

DHCP

Dynamic Host Configuration Protocol

DSR

Data Set Ready

DTR

Data Terminal Ready

E

ext3

The file system commonly used by the Linux operation system.

F

FIR

Finite Impulse Response

FTP

File Transfer Protocol

G

GPS

Global Positioning System

H

HTTP

Hypertext Transfer Protocol

I

ID

Identification

IDE

Integrated Device Electronics

IIR	Infinite Impulse Response
IP	Internet Protocol
L	
LAN	Local Area Network
LED	Light Emitting Diode
LP	Long Period
LTA	Long Term Averaging
N	
NEIC	National Earthquake Information Center
P	
PLL	Phase Locked Loop
PPP	Point-to-Point Protocol
PRB	Pseudo-Random Binary
R	
RF	Radio Frequency
RI	Request for Information
RMA	Return Merchandise Authorization
RMS	Root Mean Square

RTS	Request to Send
Rx	Receive
S	
SEED	Standard for the Exchange of Earthquake Data
SEG Y	A file format developed by the Society of Exploration Geophysicists for storing geophysical data.
SLIP	Serial Line Internet Protocol
SOH	State-Of-Health
SP	Short Period
STA	Short Term Averaging
T	
TCP/IP	Transmission Control Protocol/Internet Protocol
TDMA	Time Division Multiple Access
TNC	Terminal Node Controller
TTL	Time-To-Live
Tx	Transmit
U	
UDP	User Datagram Protocol
UI	User Interface

URL	Uniform Resource Locator
USB	Universal Serial Bus
UTC	Universal Time Coordinated

I.2 List of Unit Abbreviations and Symbols

Table I-1 provides a list of unit abbreviations and symbols commonly used in Nanometrics documentation.

Table I-1 Unit abbreviations and symbols

Abbreviation or Symbol	Definition	Abbreviation or Symbol	Definition
°	degree	lb	pound
μ	micro	m	metre
Ω	ohm	m/s	metre per second
A	ampere	m/s ²	metre per second, squared
AC	alternating current	mA	milliampere
b	bit	MB	megabyte
B	byte	MΩ	megaohm
bps	bits per second	mi.	mile
C	Celsius	mL	millilitre
cm	centimetre	mm	millimetre
dB	decibel	ms	millisecond
DC	direct current	MTU	maximum transmission unit
F	farad	mV	millivolt
ft.	foot	mW	milliwatt
g	gram	N	Newton
g	gravity	nF	nanofarad
GB	gigabyte	ns	nanosecond
Hz	hertz	rad	radian
in.	inch	rad/s	radian per second
KB	kilobyte	s	second
kg	kilogram	sps	samples per second
kHz	kilohertz	U	rack unit
kΩ	kiloohm	V	volt
kW	kilowatt	V _{pp}	Volts peak-to-peak
L	litre	W	watt

About Nanometrics

Nanometrics is a world leader in the development of precision instrumentation, network technology, and software applications for seismological and environmental studies. Using Nanometrics technology, our customers establish and grow research networks that are often located in extreme environments such as the frozen Arctic and Antarctic, the arid deserts of the Middle East, the jungles of South America, and the depths of the world's oceans. Many of these are mission-critical national and regional networks that demand the highest possible data quality and availability.

Nanometrics provides end-to-end solutions that include a growing portfolio of broadband and strong motion seismometers, dataloggers and Digitizers, satellite ground station systems for remote site data collection, and software applications for data and network analysis and management. To support this portfolio, Nanometrics also provides global systems engineering services for design, installation, and support of complete networks.

Our head office, research and development centre, and production facility are located in the Kanata North Business Park of Ottawa, the high-technology heart of Canada's capital region.

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Contacting Technical Support

If you need technical support please submit a request on the Nanometrics technical support site or by email or fax. Include a full explanation of the problem and related information such as log files.

Support site: <http://support.nanometrics.ca>
Email: techsupport@nanometrics.ca

